(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
25 October 2001 (25.10.2001)

PCT

(10) International Publication Number
WO 01/80574 A2

(51) International Patent Classification[7]: H04Q 1/00

(21) International Application Number: PCT/US01/11494

(22) International Filing Date: 9 April 2001 (09.04.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
09/549,133 13 April 2000 (13.04.2000) US

(71) Applicant: ADC TELECOMMUNICATIONS, INC. [US/US]; 12501 Whitewater Drive, Minnetonka, MN 55343 (US).

(72) Inventors: SWAM, Steven, M.; 3024 Marcia Lane, Shakopee, MN 55379 (US). SIT, Eric, K.; 7536 Carnelian Lane, Eden Prairie, MN 55346 (US). MORGENSTERN, Todd, A.; 14840 Oakcrest Circle, Savage, MN 55378 (US).

(74) Agent: BRUESS, Steven, C.; Merchant & Gould P.C., P.O. Box 2903, Minneapolis, MN 55402-0903 (US).

(81) Designated States *(national)*: AE, AG, AL, AM, AT, AT (utility model), AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, CZ (utility model), DE, DE (utility model), DK, DK (utility model), DM, DZ, EE, EE (utility model), ES, FI, FI (utility model), GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (utility model), SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

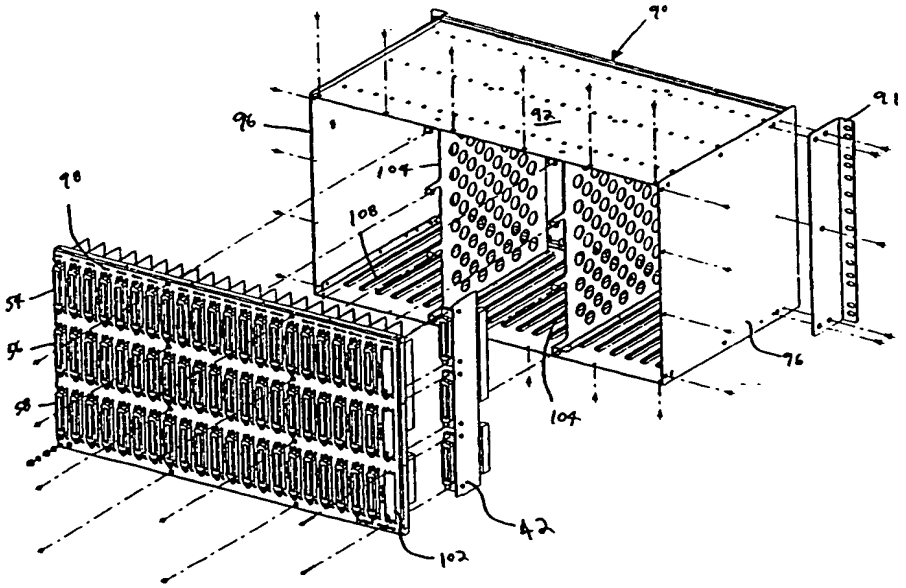
Declarations under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii)) for all designations*

— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii)) for all designations*

[Continued on next page]

(54) Title: SPLITTER ARCHITECTURE FOR A TELECOMMUNICATION SYSTEM



(57) Abstract: An interface card adapted to be mounted at the back plane of a splitter chassis. The interface card includes card edge connectors for providing connections with a splitter card. The interface card also includes cable connectors for inputting mixed voice and data, and for outputting data and voice signals. Tracings are provided on the interface card for interconnecting the cable connectors and the card edge connectors. The tracings are configured such that first tracings carrying data signals from the splitter card to the cable connectors do not cross second tracings carrying voice signals form the splitter card to the cable connectors.

WO 01/80574 A2

Published:
— *without international search report and to be republished upon receipt of that report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

SPLITTER ARCHITECTURE FOR A TELECOMMUNICATIONS SYSTEM

This application is being filed as a PCT International Patent Application in the name of ADC Telecommunications, Inc., a U.S. national corporation, designating all countries except the US, on 09 April 2001.

Background of the Invention

Telecommunications systems commonly include cables containing bundles of twisted pairs of conductors for transmitting telecommunications signals (e.g., voice only signals, data only signals, and combined/mixed voice and data signals, etc.). In these systems, mating connectors (e.g., 25 pair Telco or Amp connectors) are used to couple the cables to telecommunications equipment for processing. In a twisted pair telephone carrier system servicing residential and/or businesses, the system may include an MDF (Main Distribution Frame), a POTS (Plain Old Telephone Service) splitter for separating voice and date signals, and a DSLAM (Digital Subscriber Line Access Multi-Plexer). For most systems, it is desirable to maximize the splitter densities. Other important considerations include scalability, serviceability, reduction of cross-talk, ease of manufacture and cost.

Summary of the Invention

One aspect of the present invention relates to a splitter architecture that accommodates both scalability and serviceability for voice band and ISDN (Integrated Services Digital Network) applications of a digital subscriber line (DSL), while fully supporting lifeline POTS and lifeline ISDN service requirements. By way of example, the DSL's can include asymmetrical digital subscriber lines (ADSL) or very high speed digital subscriber lines (VDSL).

Another aspect of the present invention relates to a telecommunications system capable of providing increased splitter densities.

Still another aspect of the present invention relates to a telecommunications system including a splitter chassis having a back plane, and back plane interface cards mounted at generally perpendicular orientations relative to the back plane. The perpendicular orientation of the back plane interface cards provides for improved splitter densities, and also improves scalability by allowing the same type of back plane interface cards to be used with chassis of different sizes by merely varying the number of interface cards mounted within the chassis.

Still another aspect of the present invention relates to a back plane interface card including card edge connectors for providing connections with a splitter card. The interface card also includes cable connectors for inputting mixed

voice and data, and for outputting data signals and voice signals. Tracings are provided on the interface card for interconnecting the cable connectors and the card edge connectors. The tracings are configured such that first tracings carrying data signals from the splitter card to the cable connectors do not cross second tracings carrying voice signals from the splitter card to the cable connectors.

A further aspect of the present invention relates to a telecommunications component including a circuit board, a first multi-pair cable connector, a second multi-pair cable connector, a third multi-pair connector and one or more card edge connectors. The first multi-pair connector is used to input twisted pair, mixed data/voice signal to the circuit board. The second multi-pair cable connector outputs twisted pair, voice signals from the circuit board. The third multi-pair cable connector outputs twisted pair, data signals from the circuit board. Alternatively, if the signals are to be filtered at a downstream location (e.g., at a DSLAM), the third multi-pair connector can output mixed voice and data signals. The card edge connectors include a group of normally closed contacts, and a group of normally open contacts. All of the normally opened contacts are grouped separately from the normally closed contacts. First tracings are provided on the circuit board for connecting the first multi-pair cable connector to the normally closed contacts. Second tracings are provided on the circuit board for connecting the normally closed contacts to the second multi-pair cable connector. Third tracings are provided on the circuit board for connecting the normally open contacts to the third multi-pair cable connectors. The traces are positioned such that none of the third tracings on the circuit board cross over any of the first or second tracings.

An additional aspect of the present invention relates to a chassis defining a back plane, and a back plane interface card mounted at the back plane of the chassis. The interface card includes a circuit board positioned at an orientation generally perpendicular with respect to the back plane. The interface card also includes a first multi-pair cable connector, a second multi-pair cable connector, a third multi-pair cable connector and one or more card edge connectors. The first multi-pair cable connector is positioned at the back plane for inputting twisted pair, mixed data/voice signals to the circuit board. The second multi-pair cable connector is positioned at the back plane for outputting twisted pair, voice signals from the circuit board. The third multi-pair cable connector is positioned at the back plane for outputting twisted pair, data signals or mixed data/voice signals, from the circuit board. The card edge connectors include normally closed contacts and normally open contacts. First tracings connect the first multi-pair cable connector to the normally closed contacts, second tracings connect the normally closed contacts to

the second multi-pair connector cable, and third tracings connect the normally open contacts to the third multi-pair connector.

Brief Description of the Drawings

Figure 1 is a diagram of a telecommunications system including an MDF, a splitter device, a DSLAM, and a voice switch;

Figure 2 is another telecommunications system including an MDF, a splitter device, a DSLAM, and a voice switch;

Figures 3A and 3B are front and side views of an exemplary twenty-five pair cable connector;

Figure 4A is a schematic illustration of a back plane interface card and a splitter card constructed in accordance with the principles of the present invention, the back plane interface card is shown including normal-through connections for supporting lifeline services;

Figure 4B shows the back plane connector card and the splitter card of Figure 4A interconnected together;

Figures 5A and 5B are plan views of opposite sides of an interface card constructed in accordance with the principles of the present invention, the plan views show a representative tracing pattern;

Figures 5C and 5D show end views of the interface card of Figures 5A and 5B;

Figure 5E shows a multi-layer tracing layout for an interface card having a slightly different tracing pattern than the embodiment of Figures 5A and 5B;

Figure 6 is a schematic depiction of an inventive configuration for a back plane interface card and a splitter card, both the back plane interface card and the splitter card are aligned at a generally perpendicular orientation relative to a chassis back plane;

Figure 7 is a perspective view of a splitter chassis constructed in accordance with the principles of the present invention, an endplate of the chassis has been removed and a splitter card has been slid from the chassis;

Figure 8 is a rear perspective view of the splitter chassis of Figure 7 with the back plane removed;

Figure 9 is a rear view of the loaded splitter chassis of Figure 7;

Figure 10 is a front view of the loaded splitter chassis of Figure 7;

Figure 11 is an exploded view of the splitter chassis of Figure 7 with the splitter cards and the back plane interface cards removed;

Figure 12 is a front perspective view of another chassis constructed in accordance with the principles of the present invention;

Figure 13 is a rear perspective view of the splitter chassis of Figure 12; and

Figure 14 is a front view of the splitter chassis of Figure 12.

While the invention is amenable to various modifications and alternative forms, specifics thereof have been shown by way of example in the drawings and will be described in detail below. It is to be understood, however, that the intention is not to limit the invention to the particular embodiments described. On the contrary, the invention is intended to cover all modifications, equivalents, and alternatives falling within the scope of the invention as defined by the appended claims.

Detailed Description

In the following detailed description, references are made to the accompanying drawings that depict various embodiments in which the invention may be practiced. It is to be understood that other embodiments may be utilized, and structural and functional changes may be made without departing from the scope of the present invention.

Referring now to Figure 1, a telecommunications system 10 is shown including an arrangement of equipment. The system 10 is representative of a telephone carrier's system for transmitting voice and data to residences and businesses. A main distribution frame (MDF) 12 is linked to a splitter device 16 (e.g., a card including POTS splitter circuits or ISDN splitter circuits). The MDF 12 is also linked to one or more DSLAM modules 18, and a voice switch 19 (e.g., a switch equipped with POTS interface line cards or ISDN interface line cards).

In use of the system 10, the splitter device 16 receives a mixed voice and data signal from the MDF 12. The splitter device 16 splits the mixed signal into split signals, and then filters the split signals. For example, one of the split signals can be filtered to provide a voice only signal (i.e., the high frequency data portion of the signal is filtered out), while the other split signal can be filtered to provide a data only signal (i.e., the low frequency voice portion of the signal is filtered out). The data only signals are passed from the splitter device 16 to the DSLAM 18. The voice only signals are passed from the splitter device 16 to the MDF 12 for transmission to the voice switch 19.

Figure 2 shows a similar telecommunications system 10' having the same components as those described with respect to the telecommunications system

10' of Figure 1. However, in the embodiment of Figure 2, voice signals are transmitted directly from the splitter device 16 to the voice switch 19.

Referring still to Figs. 1 and 2, the MDF 12, the POTS splitter device 16, the DSLAM 18 and the voice switch 19 are typically interconnected by cables 21. The cables 21 preferably each include multiple pairs of conductors for transmitting separate twisted pair signals. By way of example, the cables 21 can comprise 25 pair cables (i.e., cables each containing 25 pairs of wire conductors for transmitting 25 separate twisted pair signals). Multi-pair connectors are used to provide interconnections between the cables 21 and the components of the telecommunications system 10. For example, multi-pair connectors are typically provided at the ends of the cables 21. The multi-pair connectors at the ends of the cables 21 are commonly coupled to corresponding multi-pair cable connectors mounted at the equipment to provide connections thereinbetween.

An exemplary multi-pair cable connector 20 is shown in Figures 3A and 3B. The depicted connector 20 is a conventional connector such as a Telco or Amp connector. Preferably, the connector 20 is adapted for use with a 25 pair cable. Thus, the conductor 20 preferably includes 25 pairs of conductors 28. For clarity, only two of the pairs of conductors 28 are shown in Figures 3A and 3B.

The connector 20 includes a first end 26 defining a receptacle 27 sized for receiving a portion of a mating connector (not shown) connected at the end of a cable. The pairs of conductors 28 are positioned within the receptacle 27, and are adapted to contact corresponding conductor pairs of the mating connector. The conductors 28 extend through the connector 20 from the first end 26 to a second end 30. Portions of the conductors 28 located at the second end 30 are used to provide connections to conductor pairs of cables, wires, circuit boards, equipment, etc.

The splitter 16 of Figs. 1 and 2 can be arranged in any number of known configurations. One known splitter configuration includes a chassis having a back plane. An interface card is mounted at the back plane. The interface card includes circuit board that is parallel to the back plane of the chassis. An array of cable connectors mounted on the circuit board. The array of cable connectors includes cable connectors for inputting mixed data/voice signals to the circuit board, cable connectors for outputting voice signals, and cable connectors for outputting data signals from the circuit board. Multiple sets of card edge connectors are provided on the circuit board for allowing multiple splitter cards to interface with the circuit board. The card edge connectors include a number of normal-through connections for providing full support of lifeline POTS and lifeline ISDN services. A plurality of tracings interconnect the array of cable connectors to the sets of card edge connectors. The tracings are arranged such that first tracings carrying data

signals from the splitter cards cross over second tracings carrying voice signals from the splitter cards.

The above described configuration is problematic for a number of reasons. For example, the described crossing over of tracings may increase the cross talk that occurs at the back plane. Also, the described crossing over of tracings requires the circuit board to have a relatively large number of layers thereby increasing the manufacturing costs associated with the circuit board. Further, the configuration of the back plane interface card is not readily scalable because the size of the back plane circuit board will often need to be varied to be used with chassis of different sizes.

Figures 4A and 4B schematically illustrate a splitter architecture 40 in accordance with the principles of the present invention. The architecture 40 is particularly useful with telecommunication service options such as asymmetrical digital subscriber lines (ADSL) and very high speed digital subscriber lines (VDSL). While the signals in the schematics are shown traveling in one direction, it will be appreciated that the system is preferably bi-directional.

The architecture 40 includes a back plane interface card 42 adapted to couple with a splitter card 44. The interface card 42 is preferably mounted at a back plane 46 of a splitter chassis or housing, and includes a circuit board 48 adapted to align at a generally perpendicular angle relative to the back plane 46. The circuit board 48 includes a back edge 50 positioned generally at the back plane 46, and a front edge 52 that is forwardly offset from the back plane 46. First, second and third multi-pair cable connectors 54, 56, and 58 are mounted at the back edge 50, and first and second card edge connectors 60 and 62 are mounted at the front edge 52. The first cable connector 54 (i.e., a LINE connector as labeled in Figure 8) is adapted for inputting twisted pair, mixed data/voice signals to the interface card 42. The second and third cable connectors 56 are used to respectively output twisted pair, voice signals and twisted pair data signals from the interface card 42. These connectors can be referred to as POTS (i.e., voice) and DATA Connectors as labeled in Figure 8. The connectors 54-58 can have the same configuration as the connector shown in Figures 3A and 3B. Referring to Figure 5D, a few representative conductors 28 are shown within the connectors 54-56.

The first and second card edge connectors 60 and 62 are used to provide a connection between the interface card 42 and the splitter card 44. For example, the splitter card 44 includes first and second card edge portions 64 and 66 that are respectively received within the first and second card edge connectors 60 and 62. The card edge portion 64 includes a pair of contacts 68b (e.g., contact pads) on one side of the splitter card 44, and another pair of contacts 70b (e.g., contact

pads) on the other side of the splitter card 44. When the first card edge portion 64 is inserted within the first card edge connector 60, the contacts 68b and 70b engage respective contacts 68a and 70a of the first card edge connector 60. The contacts 68a and 70a, best shown in Figure 5C, are preferably spring contacts that normally engage one another (i.e., the contacts are normally closed). Figure 5C schematically shows a few representative contacts 68a and 70a. When the first card edge portion 64 is inserted within the first card edge connector 60, the contacts 68a and 70a are forced apart and placed into engagement with the contacts 68b and 70b of the splitter card to provide a connection thereinbetween.

Referring again to Figures 4A and 4B, the second card edge portion 66 of the splitter card 44 includes contacts 72 (e.g., contact pads) for providing a connection with the second card edge connector 62. For example, when the second card edge portion 66 is inserted into the second card edge connector 62, the contacts 72 engage respective contacts 74 provided at the second card edge connector 62 to provide a connection thereinbetween. The contacts 74 are preferably normally open (i.e., no signals are passed through the contacts 74 unless the splitter card 44 is coupled to the interface card 42). Figure 5C schematically shows a few representative few contacts 74. As shown in Figure 5C, the contacts 74 include two groups separated by a gap sized for receiving the card edge portion 66. Thus, the groups of contacts 74 are adapted for engaging contacts 72 located on opposite sides of the splitter card.

For clarity purposes, only one twisted pair circuit for the splitter architecture is shown in Figures 4A and 4B. Thus, only single pairs of the contacts 68a, 68b, 70a, 70b, 72 and 74 are shown. However, it will be appreciated that the actual number of contacts provided will be dependent upon the capacity of the connectors 54, 56, and 58; and the number of splitters provided at the splitter card 44. For example, if the cable connectors 54-56 and 58 comprise conventional 25 pair connectors, 24 separate pairs of the contacts 68a, 68b, 70a, 70b, 72 and 74 are preferably provided. In such a case, the twenty fifth pair of conductors in the cable connectors is preferably grounded or inactive. Thus, in such an embodiment, the splitter architecture 40 has the capacity to process 24 separate twisted pair signals. Of course, the capacity of the splitter architecture 40 can be varied. For example, in certain embodiments it may be desirable to provide more or fewer splitters at the splitter card 44 (e.g., any number of splitters can be provided such as 8, 24, 48, 96, etc.). Thus, the number of separate circuit paths provided by the splitter architecture 40 can be varied accordingly.

With respect to the splitter card 44, it is preferred for all of the contacts 68b and 70b to be grouped separately from the contacts 72. For example,

all of the contacts 68b and 70b of the splitter card are preferably provided on the first card edge portion 64, while all of the contacts 72 of the splitter card are preferably provided at the second card edge portion 66. In a card with 24 splitters, 48 of the contacts 72 can be provided at the second card edge portion 66, and 48 of each of the contacts 68b and 70b can be provided at the first card edge portion 64.

Referring still to Figures 4A and 4B, the cable connector 54 is connected to the pair of contacts 68a by first tracings 76; the pair of contacts 70a is connected to cable connector 56 by second tracings 78; and the pair of contacts 74 is connected to cable connector 58 by third tracings 80. Once again, for clarity and ease of explanation, the circuit pathway for only a single twisted pair signal has been illustrated in Figures 4A and 4B.

Figures 5A-5D show the back plane interface card 42 equipped with 24 separate circuits capable of handling 24 different twisted pair signals. In the embodiment of Figures 5A-5D, all of the normally closed contacts 68a and 70a are provided at the first card edge connector 60, and all of the normally open contacts 74 are provided at card edge connector 62. Thus, the normally closed contacts 68a and 70a are grouped separately from the normally open contacts 74. This particular configuration is advantageous because a more simplified tracing layout can be used. For example, because the normally closed contacts 68a and 70a are grouped separately from the normally open contacts 74, none of the third tracings 80 are required to cross over any of the first or second tracings 76 and 78. This helps reduce manufacturing costs by reducing the number of layers required to manufacture the circuit board 48. Additionally, the reduction in crossing of the tracings may assist in reducing cross talk at the back plane 46.

Figure 5E shows a multi-layer view of another interface card 42' constructed in accordance with the principles of the present invention. The card has a similar construction as the card 42 shown in Figures 5A-5D. For example, both cards include cable connectors 54-56, as well as card edge connectors 60 and 62. Also, card 42' has tracings 76', 78' and 80' that serve the same functions as tracings 76, 78 and 80 of the card 42; but are arranged in a slightly different pattern. As previously described with respect to tracings 76-80, tracings 76', 78' and 80' are preferably configured such that none of tracings 80' cross over any of tracings 76' and 78'.

As shown in Figures 5A-5E, the normally open and closed contacts are grouped separately by placing such contacts on separate connectors. It will be appreciated that alternative grouping techniques can also be used. For example, the normally open and closed contacts can be separately grouped (i.e., not mixed or alternated) on a common connector. In one embodiment, all of the contacts can be

grouped separately on a single connector. Additionally, for some applications, it may be desirable to use more than two connectors. For example, the group of normally closed connectors could be split between two connectors and the open contacts could be provided on a third connector.

Referring back to Figures 4A and 4B, the splitter card 44 includes a plurality of splitters 82 (e.g., 24 splitters) The contacts 68b, 70b and 72 are shown connected to one of the splitters 82 by tracings. For example, tracings 84 connect the contacts 68b to the splitter 82, tracings 86 connect the contacts 70b to the splitter 82, and tracings 88 connect the contacts 72 to the splitter 82. While not shown for clarity purposes, it will be appreciated that similar contacts and tracings are provided for each of the twenty four splitters 82 shown in Figures 4A and 4B.

The splitters 82 can have a number of different configurations. For example, the splitters 82 can comprise POTS splitter circuits. A conventional POTS circuit functions to split a composite signal (i.e., a mixed voice/data signal) into two composite signals. One of the split composite signals is typically passed through one or more low pass filters capable of passing the relatively lower frequency voice content of the composite signal (e.g., less than about 4 kHz) and rejecting the composite signal content above the voice band (e.g., 30 kHz and above). The other split composite signal can be passed through a high pass filter that passes the composite signal content associated with the data band (e.g., about 30 kHz and above), and rejects the relatively lower frequency voice content of the composite signal. Alternatively, the other split signal can be unfiltered such that the signal remains a composite signal. For such an embodiment, it is assumed that the DSLAM or other digital multi-plexer that ultimately receives the composite signal will provide any required high-pass filter elements to remove the relatively low frequency voice signal content of the composite signal. It will further be appreciated that ISDN filter circuits could also be used.

Figures 4A and 4B show two modes of operation for the back plane interface card. Figure 4A shows the back plane interface card 42 in a normally closed mode in which the interface card 42 is not connected to the splitter card 44. In such a mode, an analog voice signal (e.g., from an MDF) is inputted to the interface card 42 through connector 54. Once at the interface card 42, the voice signal is transmitted through the first tracings 76 to contact 68a. Because the splitter card 44 is not connected to the interface card 42, the contacts 68a and 70a are closed. Thus, the voice signal is transmitted through the contacts 68a and 70a to the second tracings 78. From the second tracings 78, the voice signal is transmitted through connector 56 and is outputted to another piece of equipment (e.g., an MDF or

switch). In this manner, the normally closed contacts 68a and 70a at the card edge connector 60 fully support lifeline POTS and lifeline ISDN services.

Figure 4B shows the splitter card 44 connected to interface card 42. When the splitter card 44 is connected to the interface card 42, the normally closed contacts 68a, 70a are opened and placed into respective engagement with contacts 68b and 70b of the splitter card 44. Also, contacts 74 of the second card edge connector 62 are concurrently closed (i.e., the contacts 74 are placed into engagement with contacts 72 of the splitter card 44). Thus, a composite signal inputted through connector 54 will be transmitted from cable connector 54 to the splitter 82 via tracings 76 and 84. At the splitter 82, the composite signal is preferably split and filtered such that a voice only signal is transmitted through tracings 86, and a data only signal is transmitted through tracings 88. The voice only signal is transmitted from tracings 86 through contacts 70b and 70a to tracings 78. From tracings 78, the voice only signal is outputted from cable connector 56 to a piece of equipment (e.g., an MDF or switch). The data only signal is transmitted through contacts 72 and 74 to tracings 80. From tracings 80, the data only signal is output through connector 58 to a piece of equipment (e.g., a DSLAM).

Figure 6 is a schematic illustration showing the relative orientations between the back plane interface card 42 and the splitter card 44. As shown, when the splitter card 44 is connected to the interface card 42, the two cards are aligned generally parallel with respect to one another. Thus, as so positioned, both of the cards 42 and 44 are aligned perpendicular relative to the back plane 46 of the chassis. Such a configuration has been found to assist in greatly increasing the splitter density of a given chassis. Such a configuration also improves scalability by allowing the signal sized unifaced cards 42 to be used with chassis of different sizes. Further flexibility can be provided by either mounting the back plane interface cards 42 in a side by side relationship within a chassis, or by stacking the interface cards 42 one on top of the other within a chassis.

Figure 7 illustrates a splitter chassis 90 constructed in accordance with the principles of the present invention. The chassis 90 is generally rectangular and includes a top side 92 positioned opposite from a bottom side 94. End plates 96 are provided for enclosing opposite ends of the chassis 90. A back plane plate 98 (as shown in Figure 8) defines a back plane of the chassis 90, and a front side 100 of the chassis 90 is generally open. The chassis 90 also includes mounting brackets 91 (shown in Figure 8) for connecting the chassis 90 to a structure such as a rack.

As best shown in Figure 8, a plurality of the back plane interface cards 42 are preferably secured to the back plane plate 98 by conventional techniques (e.g., fasteners such as bolts or screws). The back plane plate 98 defines

multiple columns of vertically spaced apart openings 102 sized for receiving the cable connectors 54, 56 and 58 of the interface cards 42. When the interface cards 42 are connected to the back plane plate 98, the connectors define an array of connectors as shown in Figure 9.

Referring to Figure 11, the chassis 90 includes intermediate dividers 104 that provide additional structural rigidity to the chassis 90. The chassis 90 also includes top and bottom tracks 106 and 108 respectively secured to the top side 92 and the bottom side 94 of the chassis 90. The top and the bottom tracks 106 and 108 oppose one another and define elongated slots that extend between the front and back sides of the chassis 90. As shown in Figure 7, the splitter cards 44 are mounted within the chassis 90 by sliding the splitter cards 44 through the open front side 100 into the tracks 106 and 108. Preferably, top and bottom ends of the splitter cards 44 are respectively received within the upper and lower tracks 106 and 108. In this manner, the tracks function to hold the splitter cards in a parallel, slightly spaced apart relation relative to one another. Front latches 110 on the splitter cards 44 hook into a top slot 112 of the chassis to retain the splitter cards 44 within the chassis 90.

As best shown in Figures 7 and 10, the back plane interface cards 42 are also mounted within the tracks 106 and 108. For example, as shown in Figure 10, top and bottom edges of the interface cards 42 are received within the tracks 106 and 108. In this manner, the tracks 106 and 108 assist in holding the back plane interface cards 42 in a perpendicular relationship relative to the back plane plate 98. The top and bottom tracks 106 and 108 also assist in maintaining a generally uniform spacing between the interface cards 42. Preferably, each back plane interface card 42 is mounted in the same set of tracks as its corresponding splitter card 44. With such a configuration, the tracks 106 and 108 assist in providing registry between the interface cards 42 and the splitter cards 44.

Figures 12-14 illustrate an alternative chassis 90' constructed in accordance with the principles of the present invention. The chassis 90' has a rectangular shape and is sized for receiving a single splitter card 44 and a single back plane interface 42. Similar to the chassis of Figure 7, the chassis 90' includes opposing tracks 106' and 108' for receiving the edges of the splitter card 44 and the interface card 42.

The above specification, examples and data provide a complete description of the manufacture and use of the composition of the invention. Since many embodiments of the invention can be made without departing from the spirit and scope of the invention, the invention resides in the claims hereinafter appended.

WE CLAIM:

1. A telecommunications component comprising:

a circuit board;

a first multi-pair cable connector for inputting twisted pair, mixed data/voice signals to the circuit board;

a second multi-pair cable connector for outputting twisted pair, voice signals from the circuit board;

a third multi-pair cable connector for outputting twisted pair, data signals or mixed data/voice signals from the circuit board;

one or more card edge connectors connected to the circuit board, the one or more card edge connectors including:

a group of normally closed contacts;

a group of normally open contacts, all of the normally open contacts being grouped separately from the normally closed contacts;

first tracings provided on the circuit board for connecting the first multi-pair cable connector to the normally closed contacts;

second tracings provided on the circuit board for connecting the normally closed contacts to the second multi-pair cable connector;

third tracings provided on the circuit board for connecting the normally open contacts to the third multi-pair cable connector; and

the tracings being positioned such that none of the third tracings on the circuit board cross-over any of the first or second tracings.

2. The telecommunications component of claim 1, further comprising a splitter card adapted for connection to the one or more card edge connectors of the circuit board, the splitter card including a plurality of splitters for splitting the mixed data/voice signals into the data signals and the voice signals.

3. The telecommunications component of claim 2, wherein the splitters comprise POTS splitters.

4. The telecommunications component of claim 3, wherein the splitter card includes at least 24 of the POTS splitters.

5. The telecommunications component of claim 1, wherein the one or more card edge connectors include a first card edge connector and a separate second card

edge connector, the first card connector including the normally closed contacts and the second card edge connector including the normally open contacts.

6. The telecommunications component of claim 5, further comprising a splitter card adapted for connection to the first and second card edge connectors of the circuit board, the splitter card including a plurality of splitters for splitting the mixed data/voice signals into the data signals and the voice signals.

7. The telecommunications component of claim 6, wherein the splitters comprise POTS splitters.

8. The telecommunications component of claim 7, wherein the splitter card includes at least 24 of the POTS splitters.

9. The telecommunications component of claim 1, further comprising a chassis including a reference back plane at which the first, second and third multi-pair cable connectors are positioned, the circuit board being aligned generally at a perpendicular orientation relative to the reference back plane.

10. The telecommunications component of claim 9, further comprising a splitter card adapted for connection to the one or more card edge connectors of the circuit board, the splitter card including a plurality of splitters for splitting the mixed data/voice signals into the data signals and the voice signals, the splitter card being aligned at a generally parallel orientation relative to the circuit board when the splitter card is connected to the one or more card edge connectors.

11. The telecommunications component of claim 10, wherein the splitters comprise POTS splitters.

12. The telecommunications component of claim 11, wherein the splitter card includes at least 24 of the POTS splitters.

13. The telecommunications component of claim 9, wherein the chassis includes opposing slots, wherein the circuit board is mounted in the slots.

14. The telecommunications component of claim 13, further comprising a splitter card adapted for connection to the one or more card edge connectors of the circuit board, the splitter card including a plurality of splitters for splitting the mixed

data/voice signals into the data signals and the voice signals, the splitter card and the circuit board being mounted in the same opposing slots when the splitter card is connected to the circuit board by the first and second card edge connectors.

15. A telecommunications component comprising:

a chassis defining a reference back plane;

an interface card mounted at the reference back plane of the chassis, the interface card including:

a circuit board positioned at an orientation generally perpendicular with respect to the back plane;

a first multi-pair cable connector positioned at the back plane for inputting twisted pair, mixed data/voice signals to the circuit board;

a second multi-pair cable connector positioned at the back plane for outputting twisted pair, voice signals from the circuit board;

a third multi-pair cable connector positioned at the back plane for outputting twisted pair, data signals or mixed data/voice signals from the circuit board;

one or more card edge connectors connected to the circuit board, the one or more card edge connectors including normally closed contacts and normally open contacts;

first tracings provided on the circuit board for connecting the first multi-pair cable connector to the normally closed contacts;

second tracings provided on the circuit board for connecting the normally closed contacts to the second multi-pair cable connector; and

third tracings provided on the circuit board for connecting the normally open contacts to the third multi-pair cable connector.

16. The telecommunications component of claim 15, further comprising a splitter card adapted for connection to the one or more card edge connectors of the circuit board, the splitter card including a plurality of splitters for splitting the mixed data/voice signals into the data signals and the voice signals, the splitter card being aligned at a generally parallel orientation relative to the circuit board when the splitter card is connected to the one or more card edge connectors.

17. The telecommunications component of claim 16, wherein the splitters comprise POTS splitters.

18. The telecommunications component of claim 17, wherein the splitter card includes at least 24 of the POTS splitters.

19. The telecommunications component of claim 15, wherein the chassis includes opposing slots, wherein the circuit board is mounted in the slots.

20. The telecommunications component of claim 19, further comprising a splitter card adapted for connection to the one or more card edge connectors of the circuit board, the splitter card including a plurality of splitters for splitting the mixed data/voice signals into the data signals and the voice signals, the splitter card and the circuit board being mounted in the same opposing slots when the circuit board and the splitter card are interconnected by the card edge connectors.

21. The telecommunications component of claim 15, wherein a plurality of the interface cards are mounted within the chassis.

22. The telecommunications component of claim 15, wherein the chassis is sized to hold a single one of the interface card.

23. The telecommunications component of claim 15, wherein all of the normally closed contacts are provided on a first card edge connector, and all of the normally open contacts are provided on a separate second card edge connector.

24. The telecommunications component of claim 23, further comprising a splitter card adapted for connection to the first and second card edge connectors, the splitter card including a plurality of splitters for splitting the mixed data/voice signals into the data signals and the voice signals, the splitter card being aligned at a generally parallel orientation relative to the circuit board when the splitter card is connected to the first and second card edge connectors.

25. The telecommunications component of claim 24, wherein the splitters comprise POTS splitters.

26. The telecommunications component of claim 25, wherein the splitter card includes at least 24 of the POTS splitters.

27. The telecommunications component of claim 23, further comprising a splitter card adapted for connection to the first and second card edge connectors, the splitter

card including a plurality of splitters for splitting the mixed data/voice signals into the data signals and the voice signals, the splitter card and the circuit board being mounted in a common pair of opposing slots defined by the chassis. connectors.

28. A splitter card comprising:

a circuit board;

a plurality of splitters mounted on the circuit board, each splitter being adapted for receiving a mixed voice and data signals and outputting first signals that are voice only and second signals that are data only;

a first card extension adapted to be received in a card edge connector, the first card extension including first contacts for receiving the mixed voice and data signals and second contacts for outputting the first signals;

a second card extension adapted to be received in a card edge connector, the first card extension including third contacts for outputting the second signals;

first tracings for transmitting the mixed voice and data signals from the first contacts to the splitters;

second tracings for transmitting the first signals from the splitters to the second contacts;

third tracings for transmitting the second signals from the splitters to the third contacts; and

all of the first and second contacts being located at the first extension and all of the third contacts being located at the second extension, wherein the first and second contacts are grouped together at a location separate from the third contacts.

29. The splitter card of claim 28, wherein 24 of the splitters are provided on the circuit board.

30. A telecommunications component comprising:

a circuit board;

a multi-pair line connector for inputting twisted pair, mixed data/voice signals to the circuit board;

a multi-pair voice connector for outputting twisted pair, voice signals from the circuit board;

a multi-pair data connector for outputting twisted pair, data signals or mixed data/voice signals from the circuit board;

one or more card edge connectors connected to the circuit board, the one or more card edge connectors including:

a first card edge connector having exclusively normally closed contacts;

a second card edge connector having exclusively normally open contacts;

first conductive pathways provided on the circuit board for connecting the line connector to the normally closed contacts;

second conductive pathways provided on the circuit board for connecting the normally closed contacts to the voice connector; and

third conductive pathways provided on the circuit board for connecting the normally open contacts to the data connector.

31. The telecommunications component of claim 30, wherein the conductive pathways are positioned such that none of the third conductive pathways on the circuit board cross-over any of the first or second conductive pathways.

32. A telecommunications chassis assembly comprising:

a chassis defining a reference back plane;

one or more printed circuit boards positioned adjacent the reference back plane;

a plurality of multi-pair line connectors for inputting twisted pair, mixed data/voice signals to the one or more circuit boards;

a plurality of multi-pair voice connectors for outputting twisted pair, voice signals from the one or more circuit boards;

a plurality of multi-pair data connectors for outputting twisted pair, data signals or mixed data/voice signals from the one or more circuit boards;

a first row of first card edge connectors positioned within the chassis, the first card edge connectors having exclusively normally closed contacts;

a second row of second card edge connectors positioned within the chassis, the second card edge connectors having exclusively normally open contacts;

the line and voice connectors being electrically connected by the one or more circuit boards exclusively to the first row of card edge connectors; and

the data connectors being electrically connected by the one or more circuit boards exclusively to the second row of card edge connectors.

33. The telecommunications chassis assembly of claim 32, wherein the first and second rows are horizontal rows.

34. A telecommunications chassis assembly comprising:

a chassis defining a reference back plane;

one or more printed circuit boards positioned adjacent the reference back plane;

a plurality of multi-pair line connectors for inputting twisted pair, mixed data/voice signals to the one or more circuit boards;

a plurality of multi-pair voice connectors for outputting twisted pair, voice signals from the one or more circuit boards;

a plurality of multi-pair data connectors for outputting twisted pair, data signals or mixed data/voice signals from the one or more circuit boards;

a first array of card edge connectors positioned within the chassis;

a second array of card edge connectors positioned within the chassis;

the line and voice connectors being electrically connected by the one or more circuit boards exclusively to the first array of card edge connectors; and

the data connectors being electrically connected by the one or more circuit boards exclusively to the second array of card edge connectors.

35. The telecommunications chassis assembly of claim 34, wherein the first and second arrays are separate rows.

36. A telecommunications component comprising:

a chassis defining a reference back plane;

an interface card mounted at the reference back plane of the chassis, the interface card including:

a circuit board positioned at an orientation generally perpendicular with respect to the back plane;

a first cable connector positioned at the back plane for inputting twisted pair, mixed data/voice signals to the circuit board;

a second cable connector positioned at the back plane for outputting twisted pair, voice signals from the circuit board;

a third cable connector positioned at the back plane for outputting twisted pair, data signals or mixed data/voice signals from the circuit board; and

one or more card edge connectors connected to the circuit board, the one or more card edge connectors including contacts electrically connected to the cable connectors by the circuit board.

37. The telecommunications component of claim 36, wherein the contacts of the one or more card edge connectors include normally closed contacts electrically connected to the first and second cable connectors.

38. The telecommunications component of claim 36, wherein a plurality of the interface cards are mounted at the reference back plane of the chassis, the plurality of interface cards having circuit boards oriented generally perpendicular with respect to the reference back plane.

39. The telecommunications component of claim 38, wherein the plurality of interface cards include 24 generally parallel interface cards.

40. The telecommunications component of claim 36, further comprising a splitter card mounted in the chassis and electrically connected to the card edge connector of the interface card.

41. The telecommunications component of claim 40, wherein the splitter card and the interface card are generally co-planar.

42. The telecommunications connector of claim 38, further comprising a plurality of splitter cards mounted in the chassis and electrically connected to the card edge connectors of the interface cards.

43. A telecommunications component comprising:

a chassis having a front and a back, the front being adapted for allowing splitter cards to be inserted into the chassis;

an interface card mounted adjacent the back of the chassis, the interface card including:

a circuit board having front and back ends and major side surfaces that extend between front and back ends, the circuit board being oriented such that the major side surfaces extend between the front and back of the chassis with the back end being of the circuit board being positioned adjacent the back of the chassis;

first, second and third cable connectors connected to the circuit board adjacent the back end of the circuit board; and

one or more card edge connectors connected to the circuit board adjacent the front end of the circuit board, the one or more card edge connectors including contacts electrically connected to the cable connectors by the circuit board.

44. The telecommunications component of claim 43, wherein the contacts of the one or more card edge connectors include normally closed contacts.

45. The telecommunications component of claim 43, wherein a plurality of the interface cards are mounted at the back of the chassis, the plurality of interface cards having circuit boards oriented generally parallel relative to one another.

46. The telecommunications component of claim 45, wherein the plurality of interface cards include 24 generally parallel interface cards.

47. The telecommunications component of claim 36, further comprising a splitter card mounted in the chassis and electrically connected to the card edge connector of the interface card.

48. The telecommunications component of claim 47, wherein the splitter card and the interface card are generally co-planar.

49. The telecommunications connector of claim 45, further comprising a plurality of splitter cards mounted in the chassis and electrically connected to the card edge connectors of the interface cards.

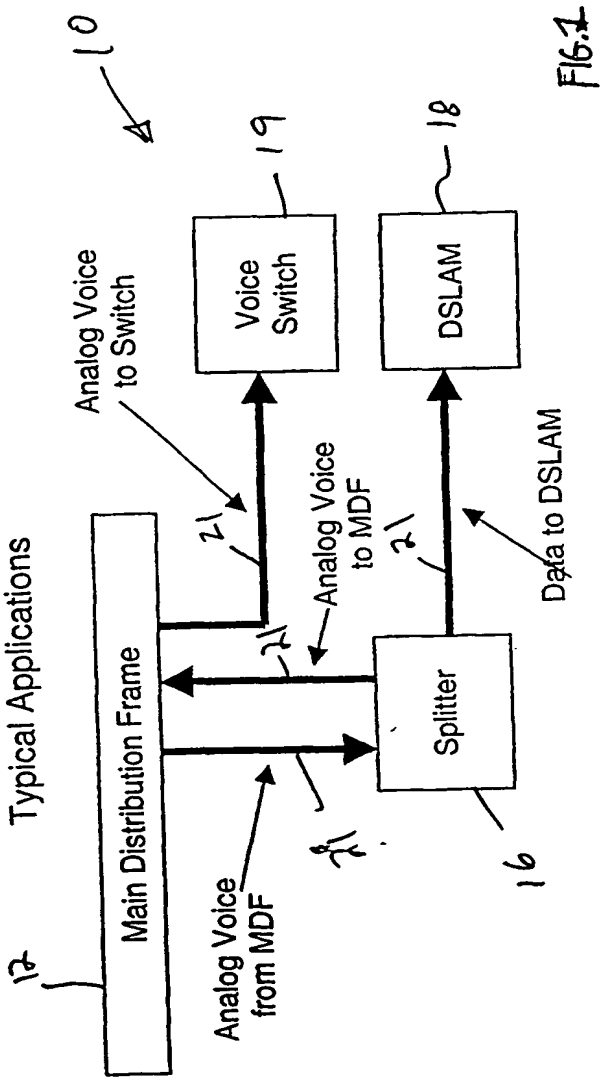

10
Typical Applications
Main Distribution Frame
12
Analog Voice from MDF
Analog Voice to MDF
Analog Voice to Switch
Voice Switch
19
DSLAM
18
Splitter
16
Data to DSLAM
21

FIG. 1

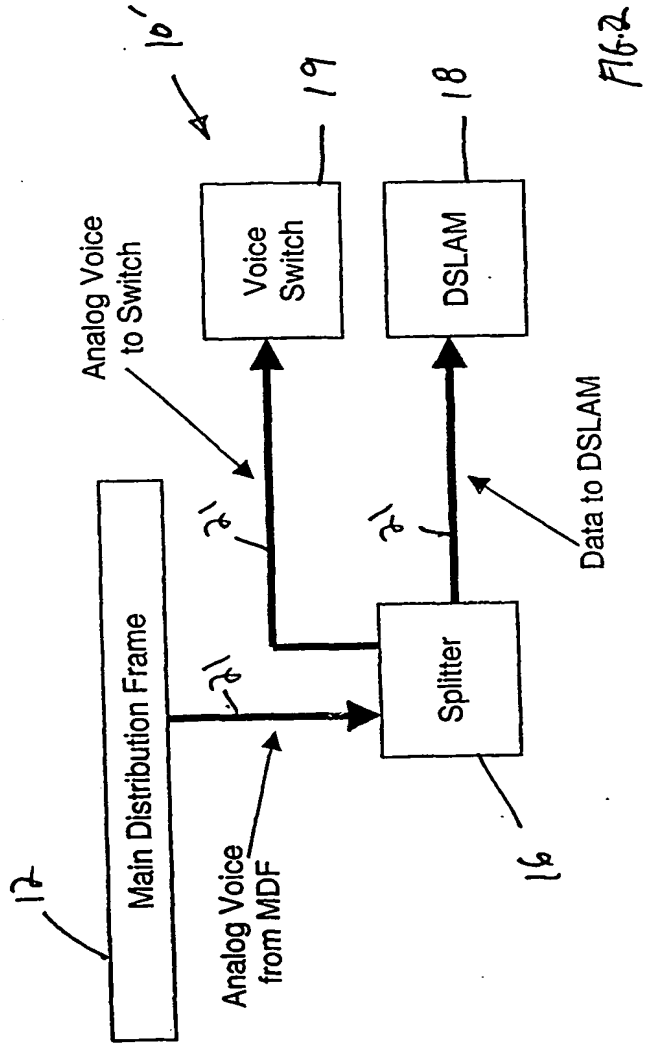

10'
Main Distribution Frame
12
Analog Voice from MDF
Analog Voice to Switch
Voice Switch
19
DSLAM
18
Splitter
16
Data to DSLAM
21

FIG. 2

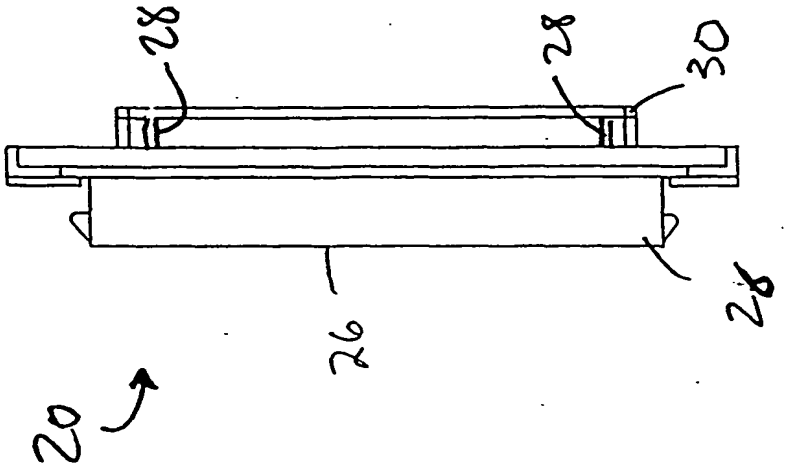


FIG. 3B

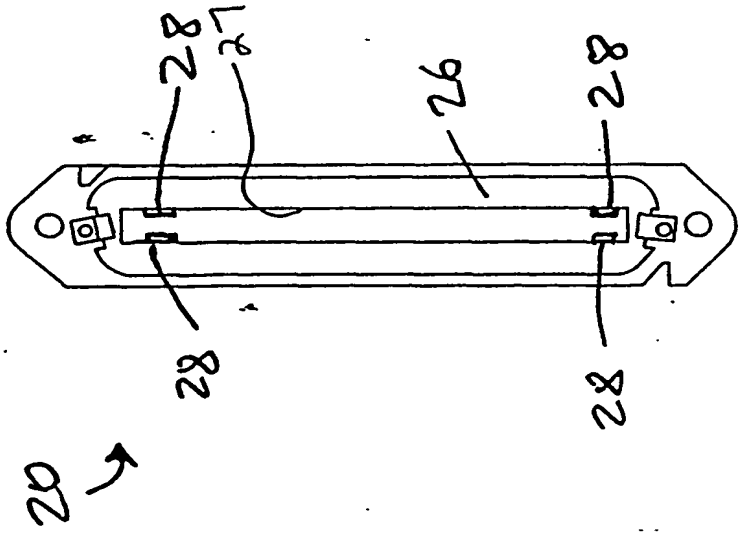


FIG. 3A

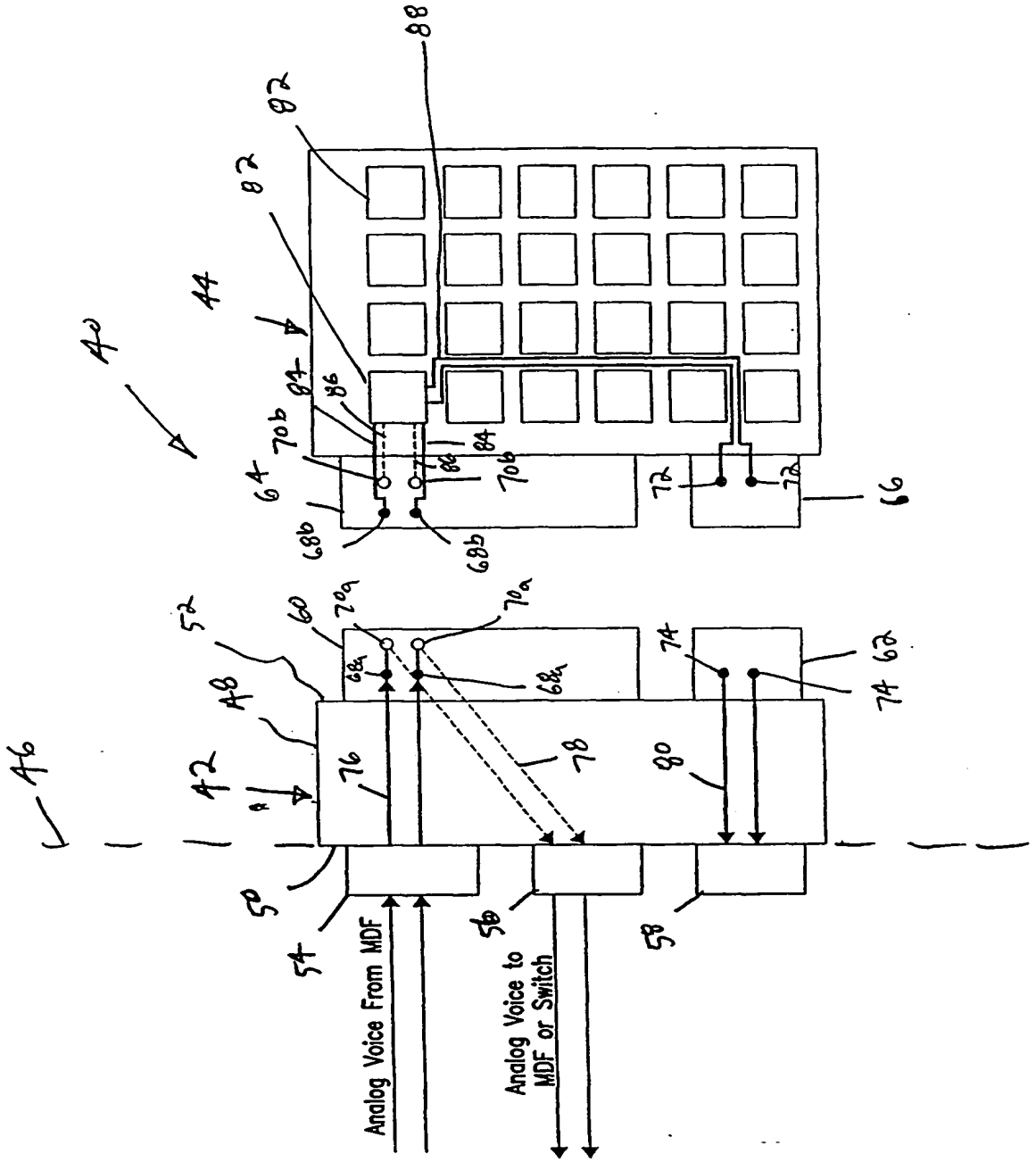

40
44
82
88
84
86
64
70b
70a
68a
68b
72
74
66
62
60
52
48
46
42
76
78
80
50
54
56
58
Analog Voice From MDF
Analog Voice to MDF or Switch

FIG. 4A

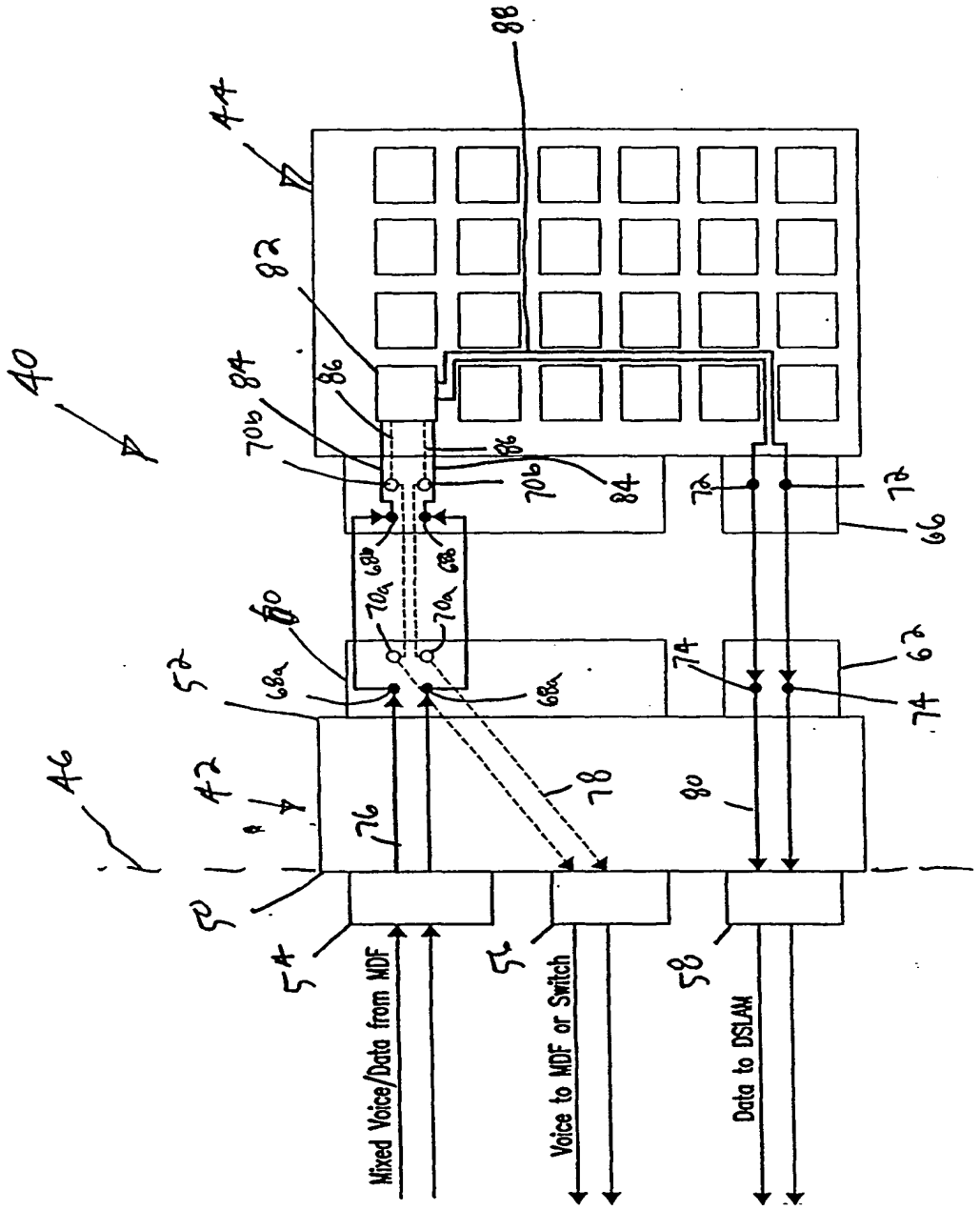

40
44
88
82
84
86
70b
68b
70a
68a
60
52
74
72
66
46
42
76
78
80
50
54
56
58
Mixed Voice/Data from MDF
Voice to MDF or Switch
Data to DSLAM

FIG. 4B

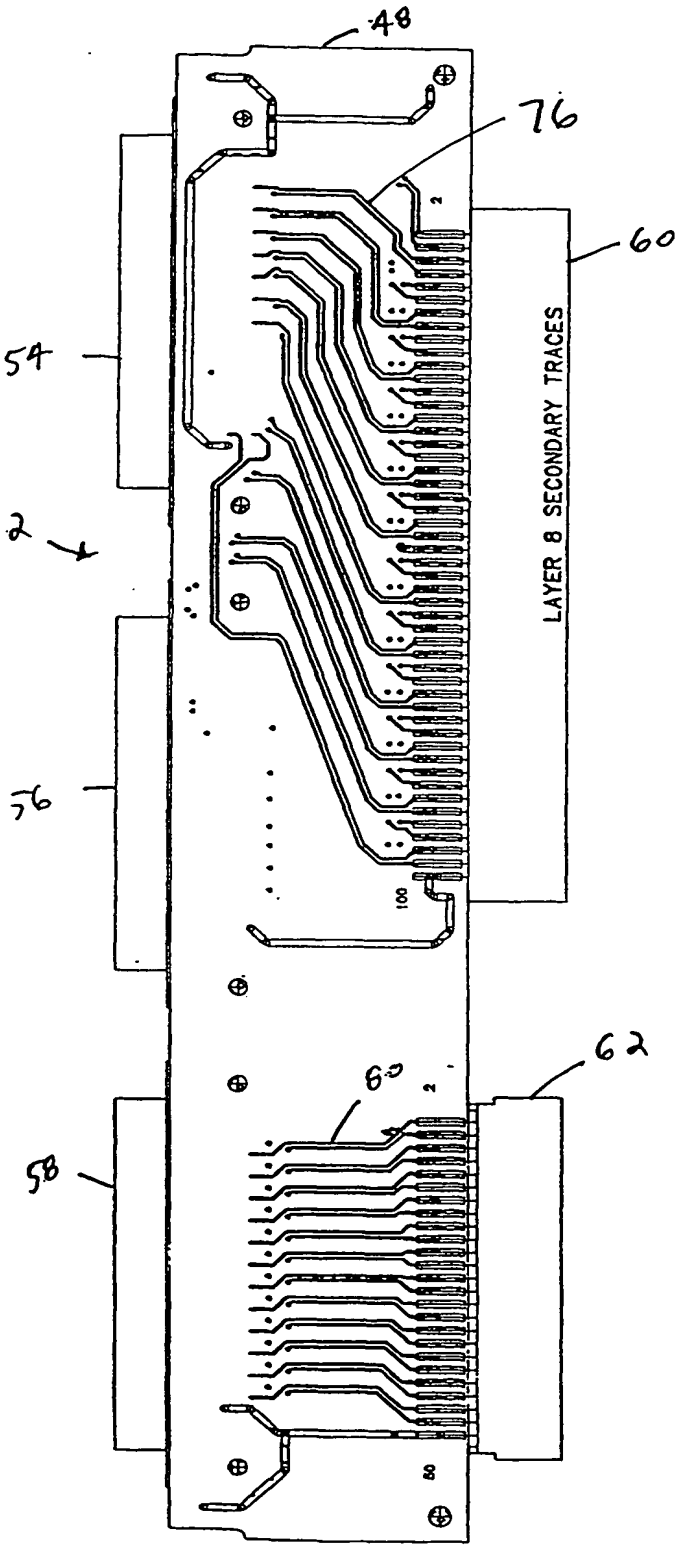

48
76
60
54
2
56
62
58
LAYER 8 SECONDARY TRACES

FIG. 5A

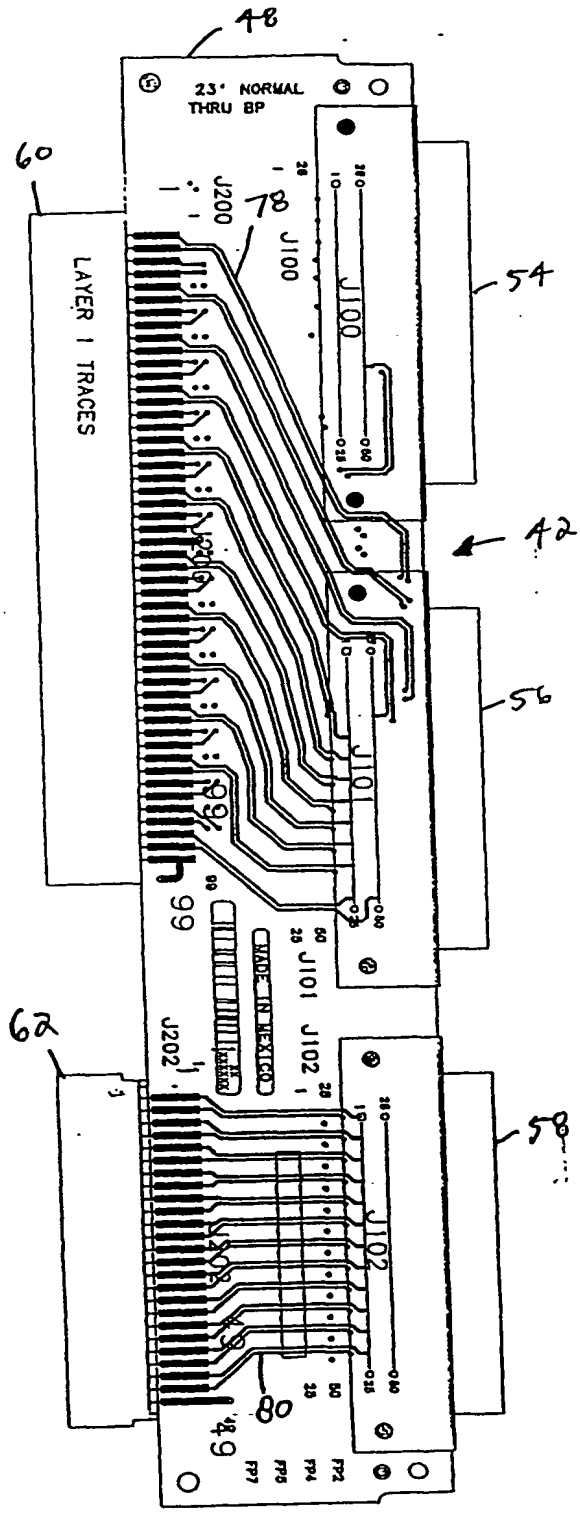

48
23° NORMAL
THRU BP
60
78
54
42
56
62
58
LAYER 1 TRACES
J100
J101
J102
J200
J202
MADE IN MEXICO

FIG. 5B

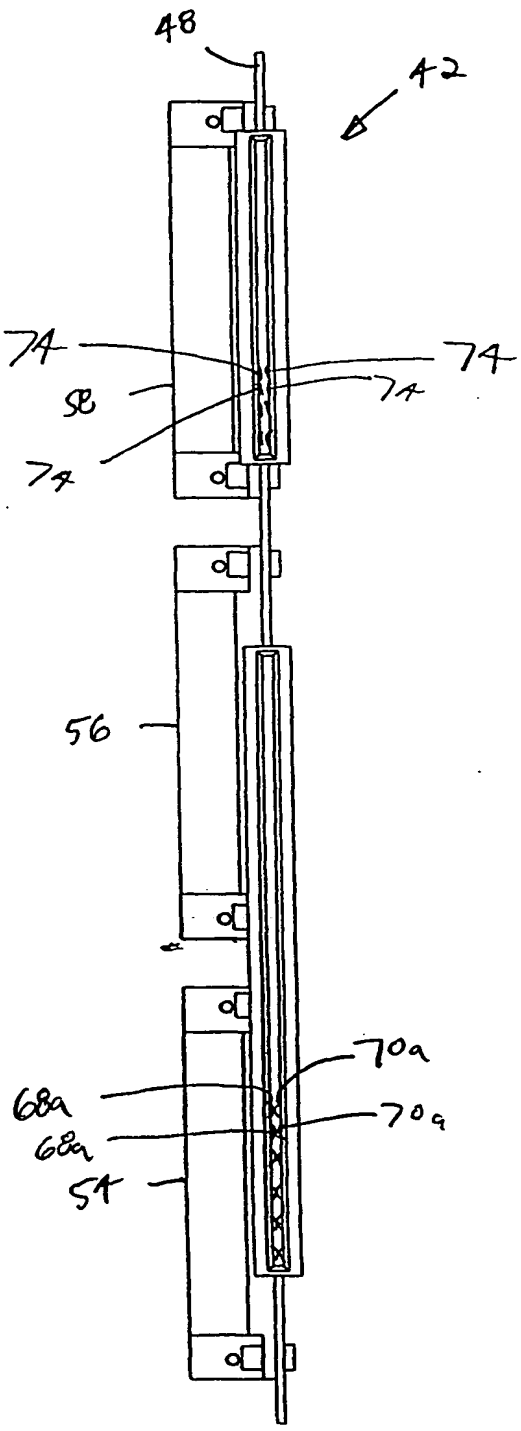


FIG. 5C

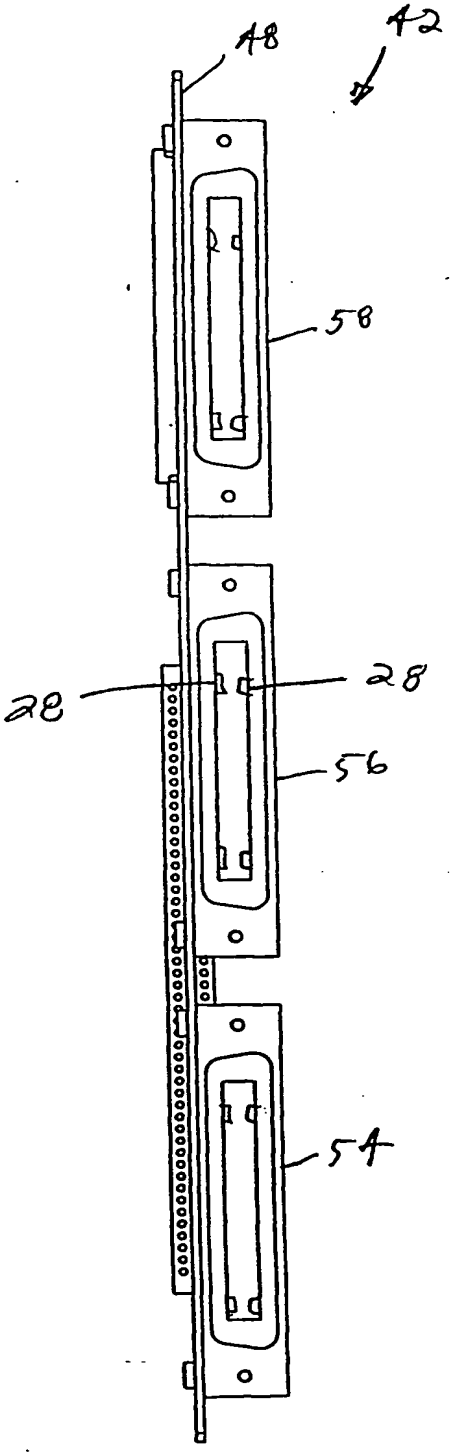


FIG. 5D

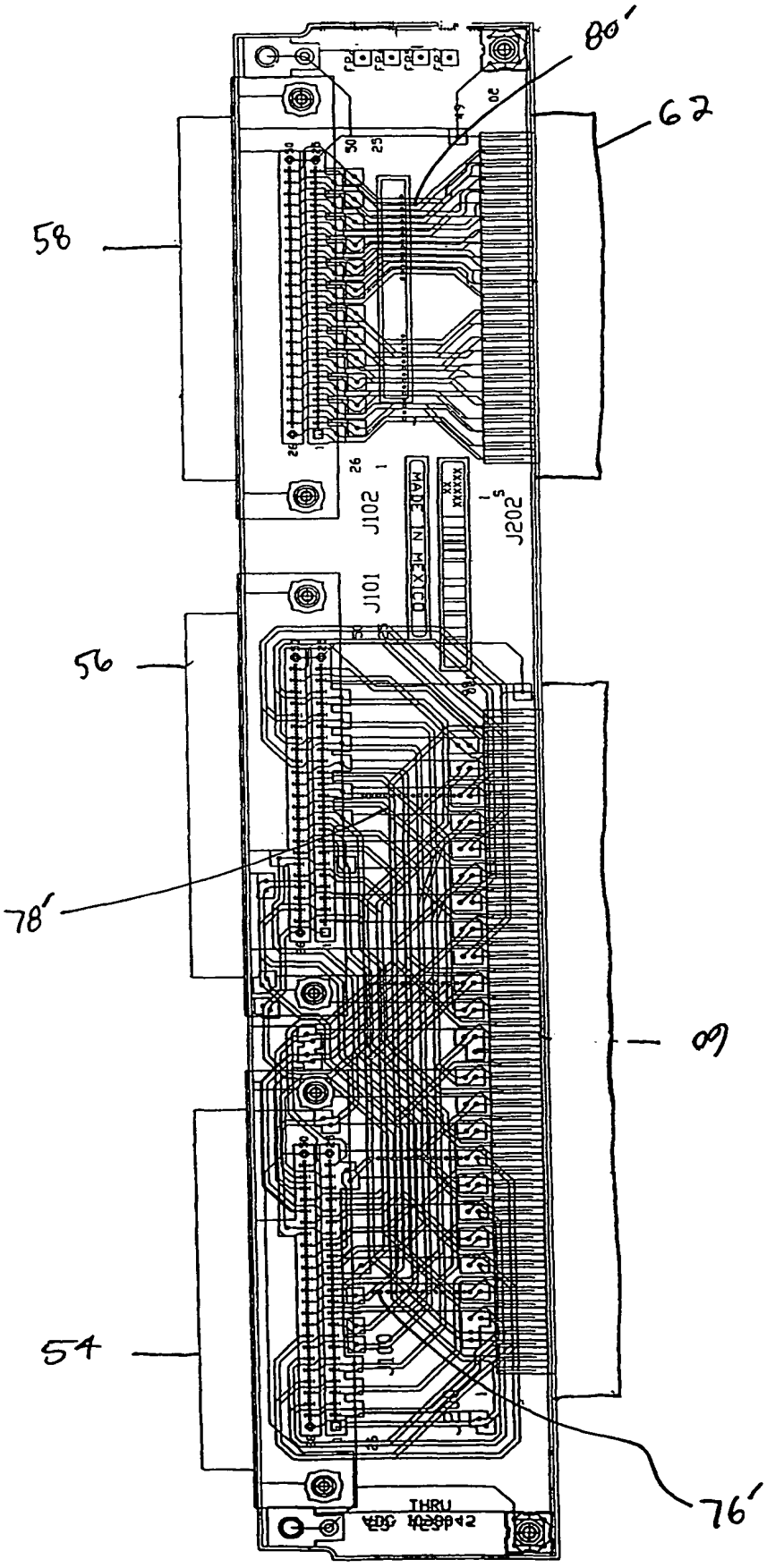


FIG. 5E

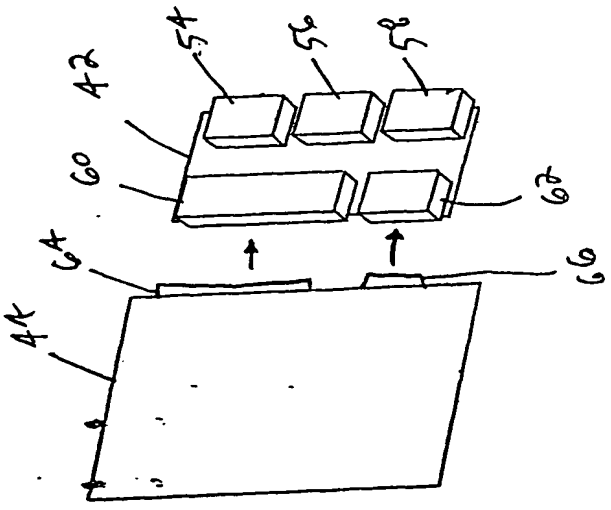


FIG. 6

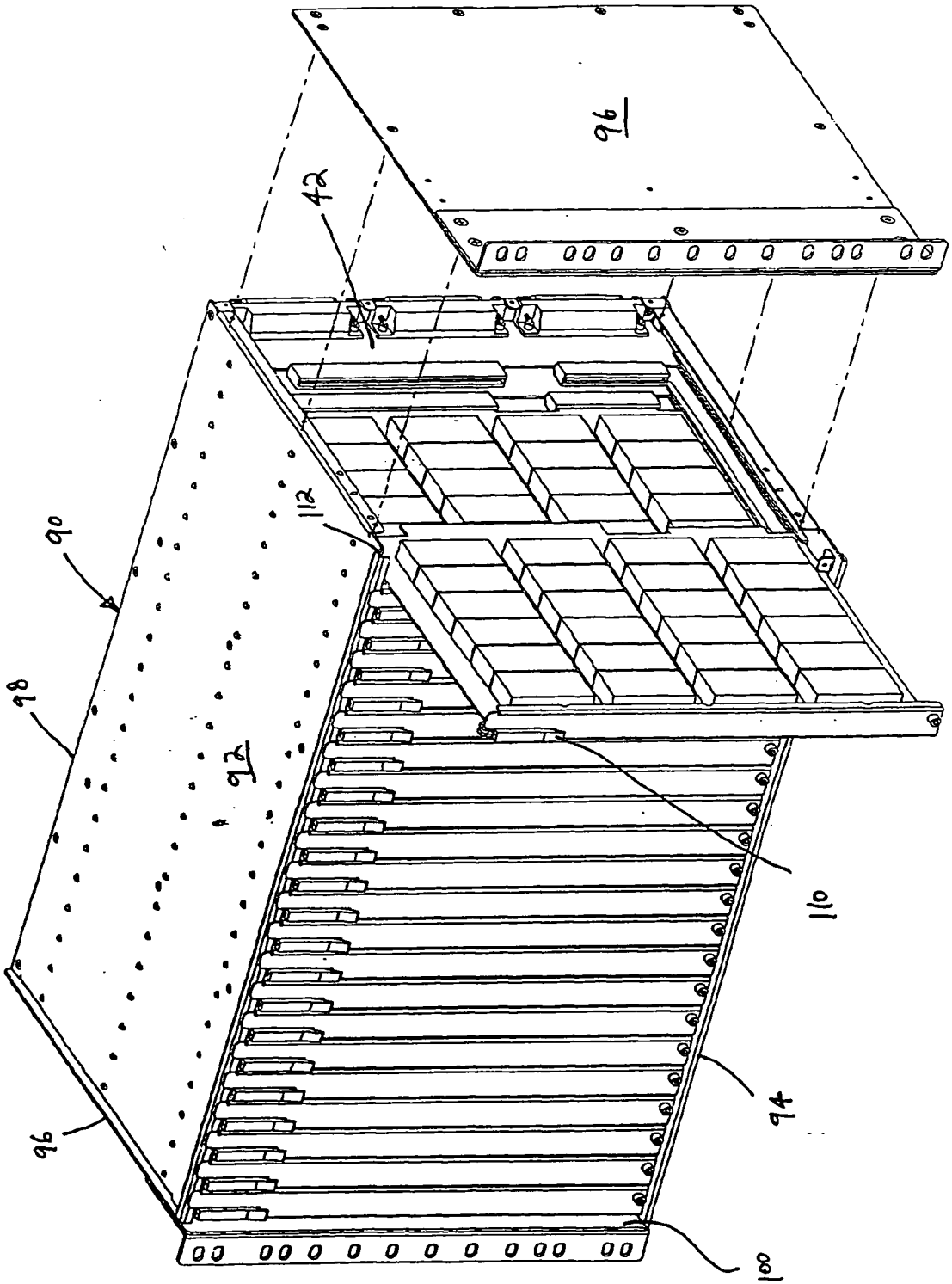


Fig. 7

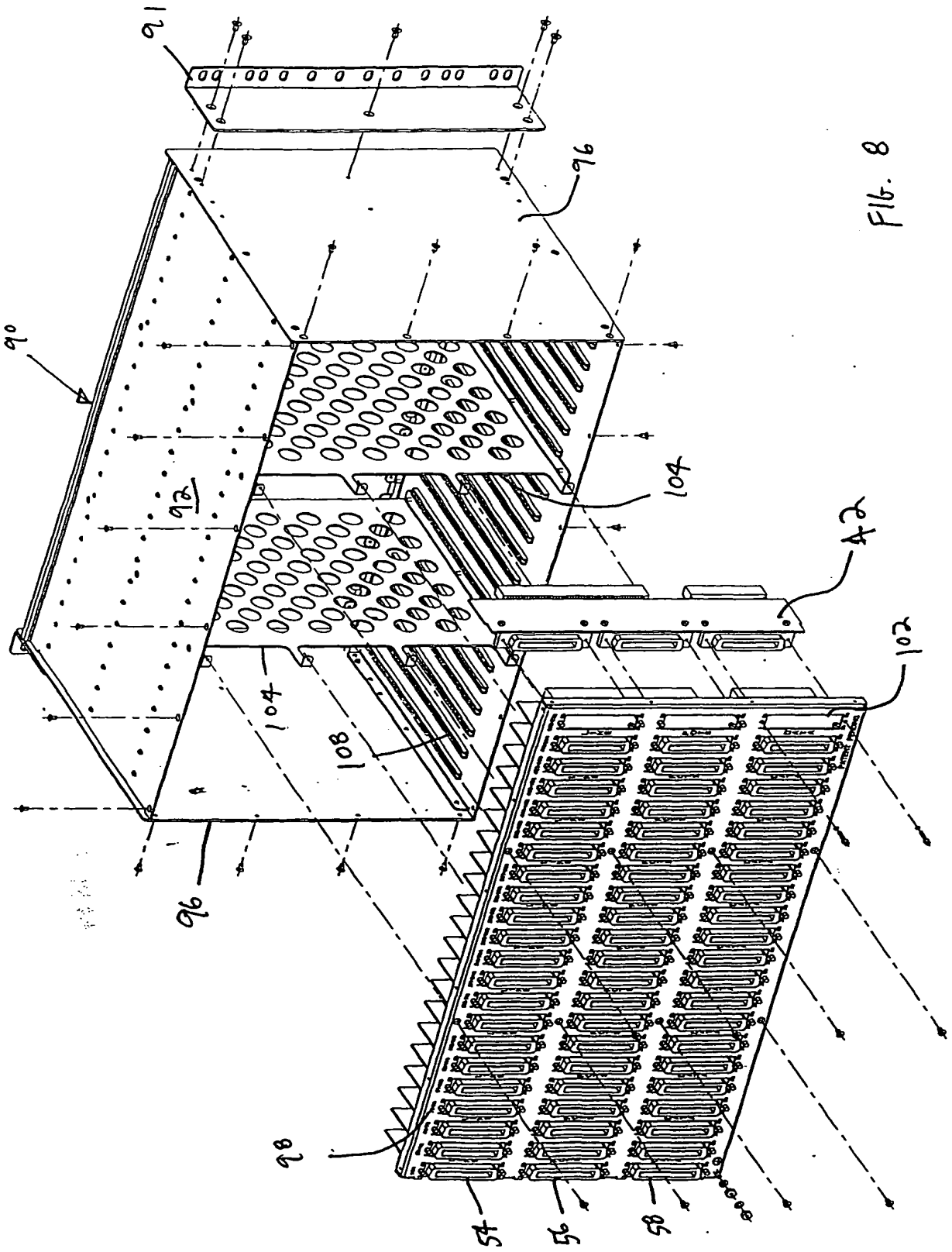
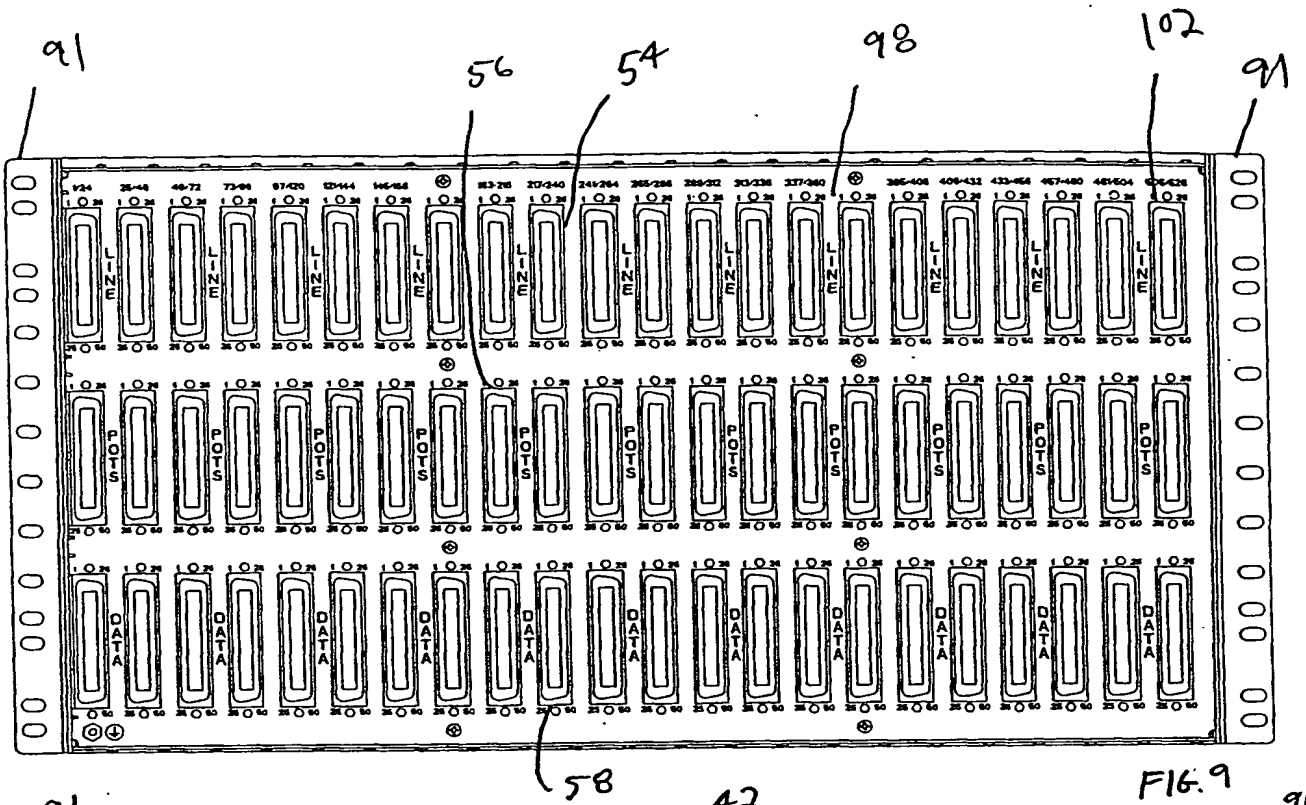
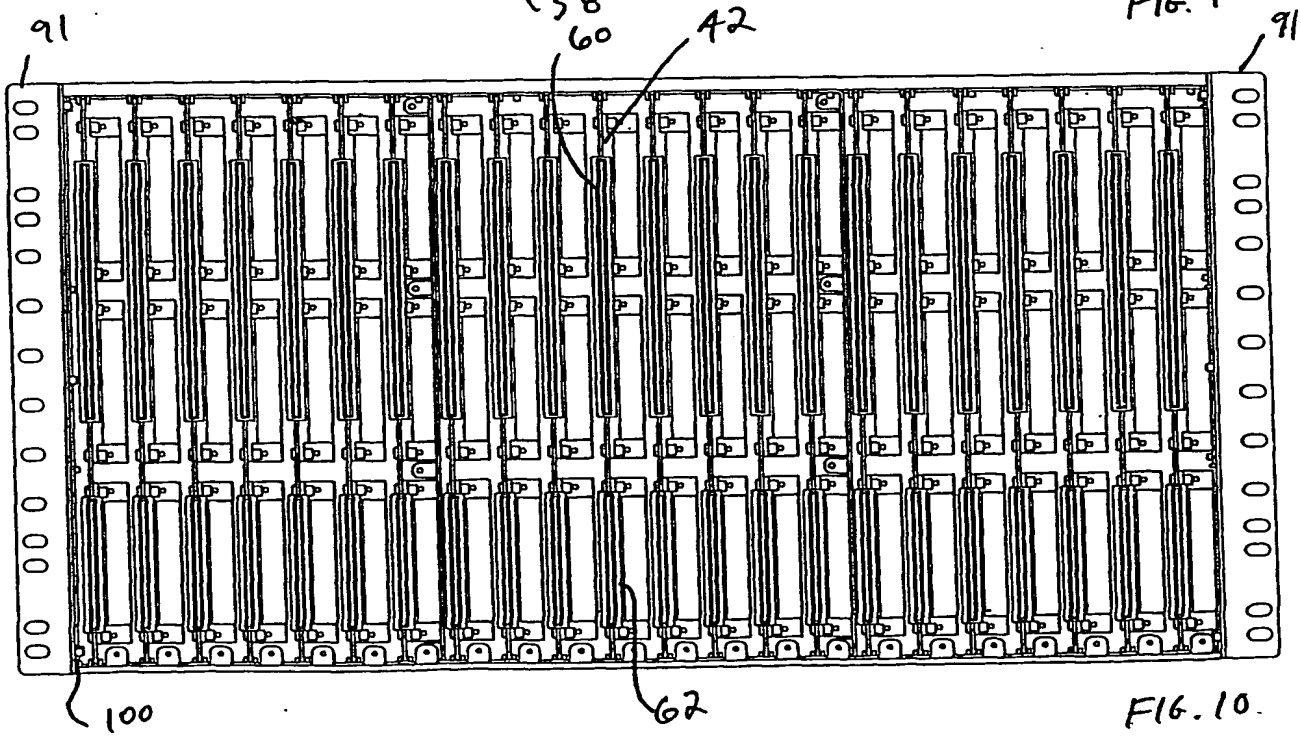


Fig. 8



F16.9



F16.10.

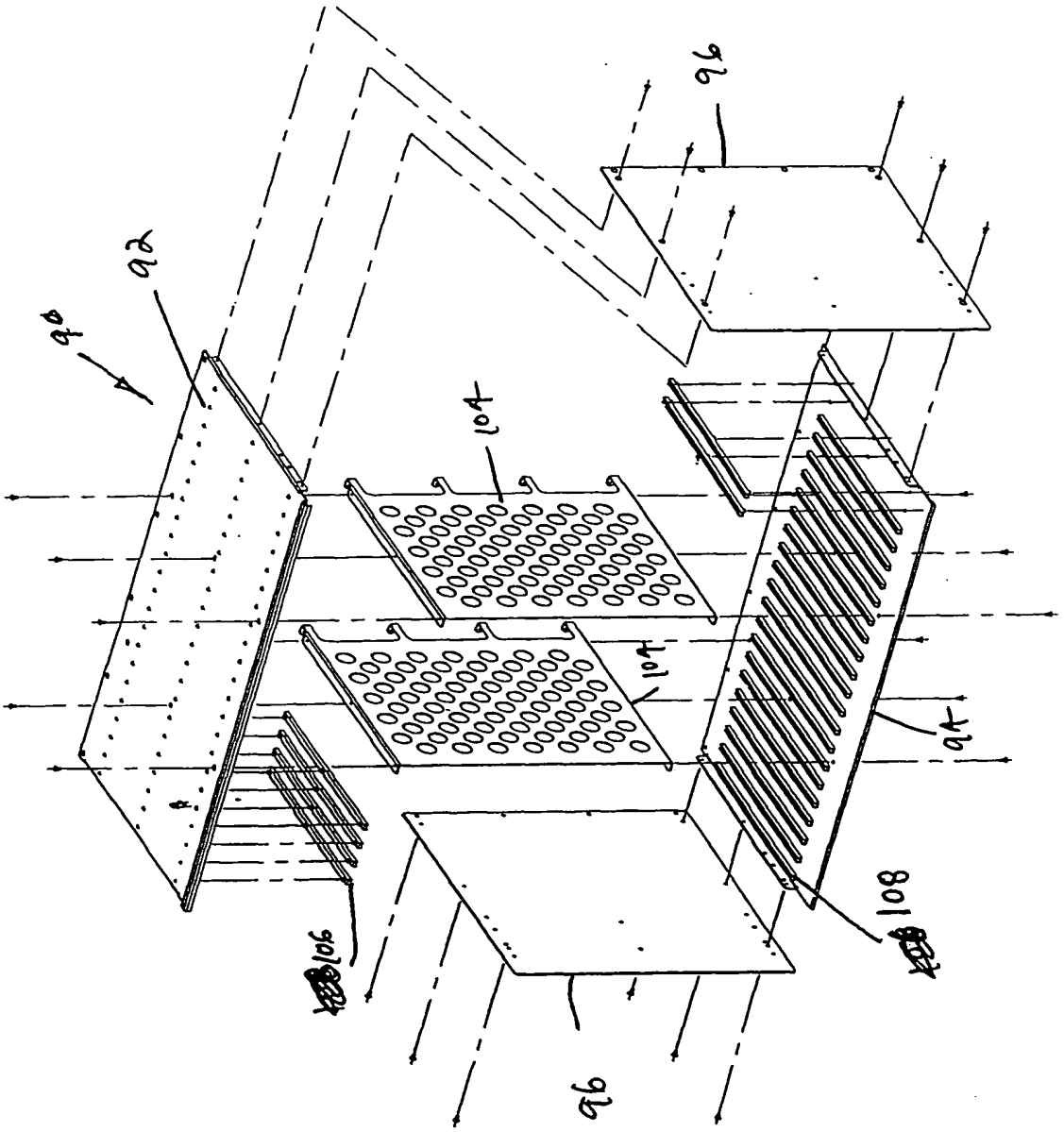


FIG. 11

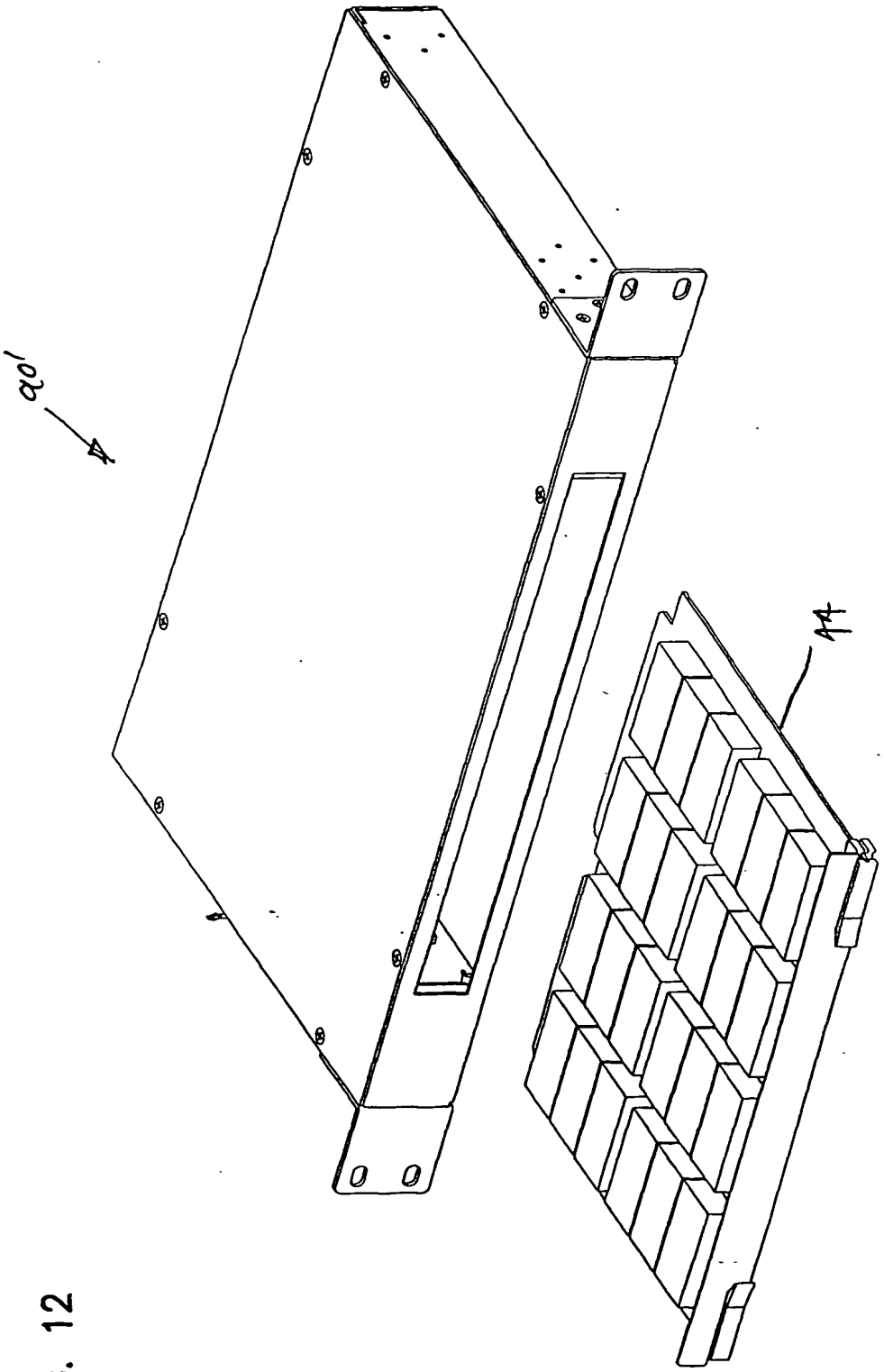


FIG. 12

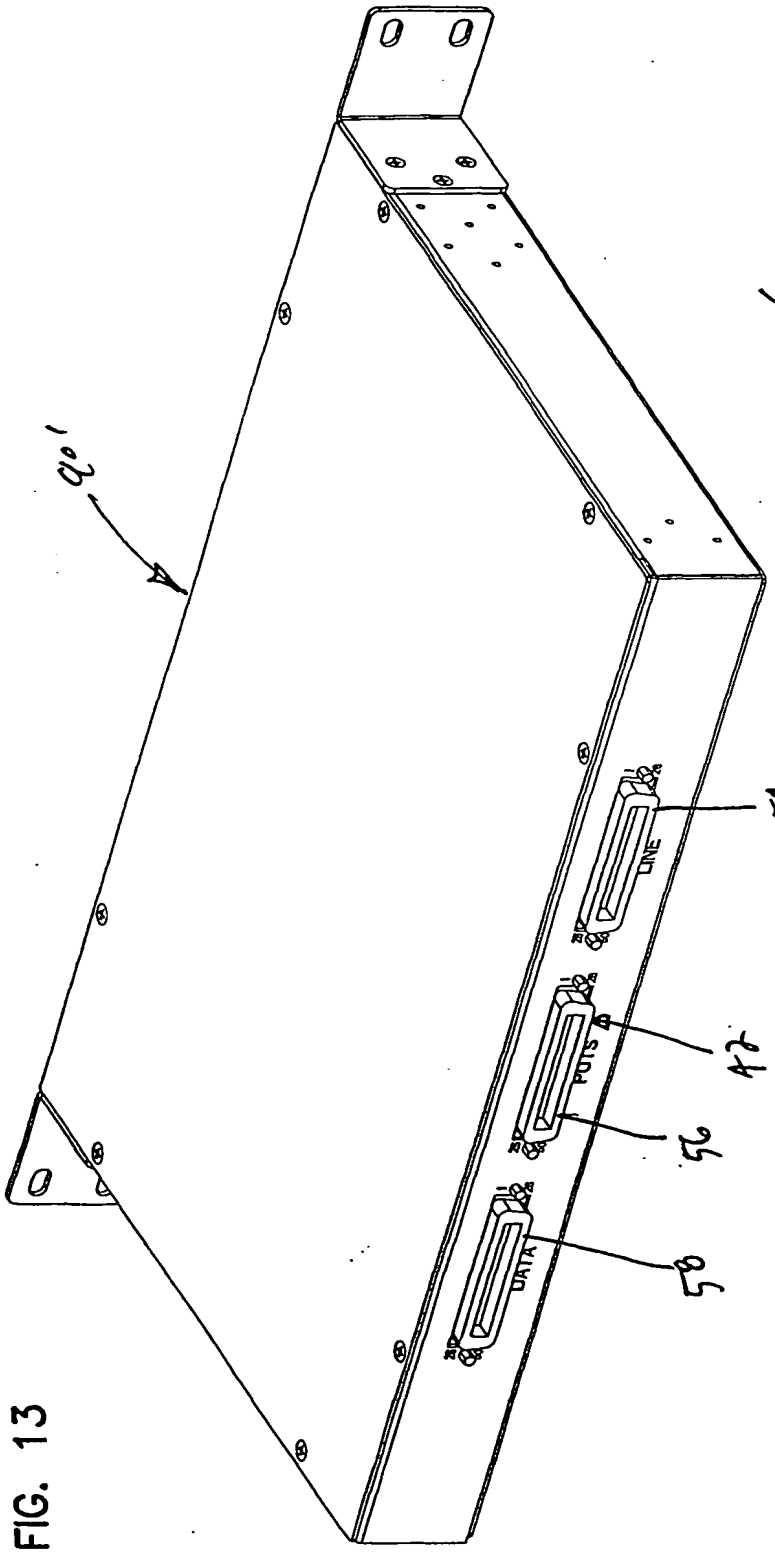


FIG. 13

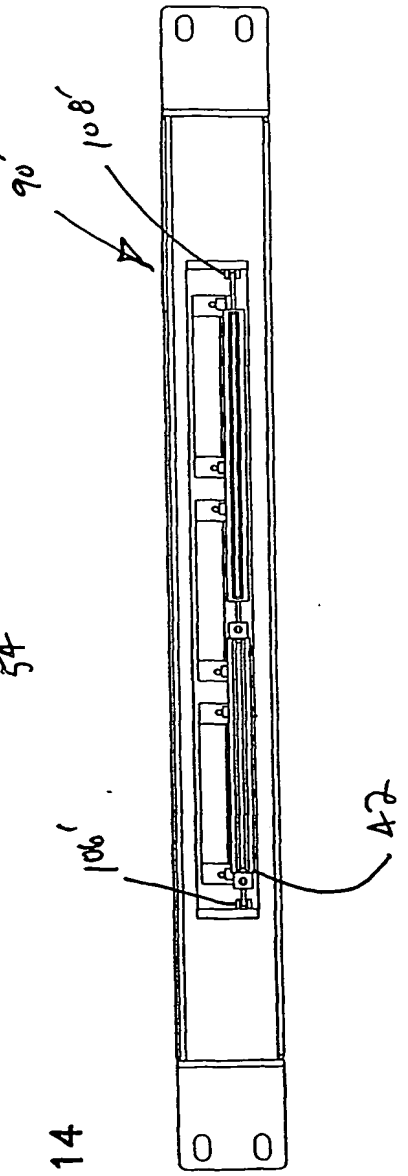


FIG. 14

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
25 October 2001 (25.10.2001)

PCT

(10) International Publication Number
WO 01/80574 A3

(51) International Patent Classification[7]: H04Q 1/10, H05K 7/14

(21) International Application Number: PCT/US01/11494

(22) International Filing Date: 9 April 2001 (09.04.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
09/549,133 13 April 2000 (13.04.2000) US

(71) Applicant: ADC TELECOMMUNICATIONS, INC. [US/US]; 13265 Technology Drive, Eden Prairie, MN 55344-2252 (US).

(72) Inventors: SWAM, Steven, M.; 3024 Marcia Lane, Shakopee, MN 55379 (US). SIT, Eric, K.; 7536 Carnelian Lane, Eden Prairie, MN 55346 (US). MORGENSTERN, Todd, A.; 14840 Oakcrest Circle, Savage, MN 55378 (US).

(74) Agent: BRUESS, Steven, C.; Merchant & Gould P.C., P.O. Box 2903, Minneapolis, MN 55402-0903 (US).

(81) Designated States *(national)*: AE, AG, AL, AM, AT, AT (utility model), AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, CZ (utility model), DE, DE (utility model), DK, DK (utility model), DM, DZ, EE, EE (utility model), ES, FI, FI (utility model), GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (utility model), SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

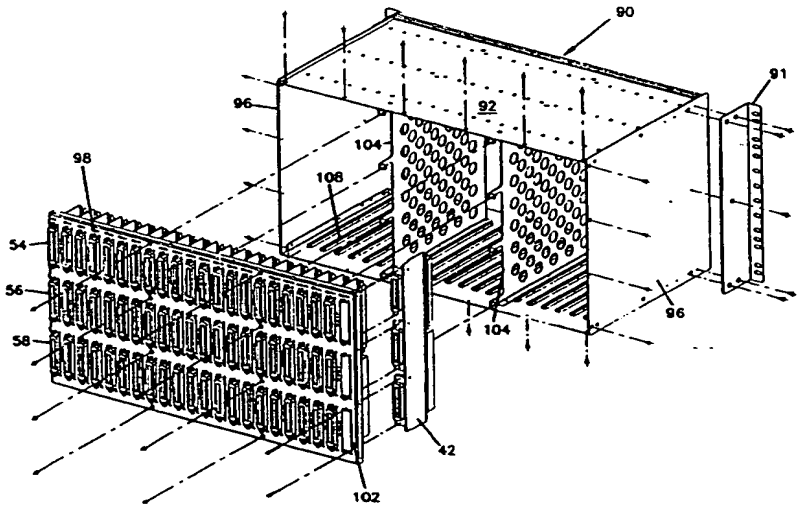
Declarations under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii)) for all designations*

— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii)) for all designations*

[Continued on next page]

(54) Title: SPLITTER ARCHITECTURE FOR A TELECOMMUNICATION SYSTEM



(57) Abstract: An interface card (42) adapted to be mounted at the back plane (46) of a splitter chassis (44). The interface card includes card edge connectors (60, 62) for providing connections with a splitter card. The interface card (44) also includes cable connectors (54, 56, 58) for inputting mixed voice and data, and for outputting data and voice signals. Tracings (76, 84, 88, 80) are provided on the interface card for interconnecting the cable connectors and the card edge connectors. The tracings are configured such that first tracings carrying data signals from the splitter card to the cable connectors do not cross second tracings carrying voice signals form the splitter card to the cable connectors.

WO 01/80574 A3

Published:
— *with international search report*

(88) Date of publication of the international search report:
25 April 2002

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

INTERNATIONAL SEARCH REPORT

Intr tional Application No
PC1/US 01/11494

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04Q1/10 H05K7/14

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04Q H05K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
WPI Data, EPO-Internal, INSPEC, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
T	WO 01 45432 A (ADC TELECOMMUNICATIONS INC) 21 June 2001 (2001-06-21) the whole document	
A	EP 0 909 102 A (SIECOR CORP) 14 April 1999 (1999-04-14) the whole document	1-49

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
4 December 2001	11/12/2001

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Vandevenne, M

2

Form PCT/ISA/210 (second sheet) (July 1992)

BNSDOCID: <WO__0180574A3_I_>

INTERNATIONAL SEARCH REPORT

.nformation on patent family members

Inte tional Application No
PCI/US 01/11494

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 0145432 A	21-06-2001	AU 2260701 A	25-06-2001
		WO 0145432 A1	21-06-2001
EP 0909102 A	14-04-1999	BR 9804159 A	21-12-1999
		CA 2249085 A1	06-04-1999
		EP 0909102 A2	14-04-1999

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
25 October 2001 (25.10.2001)

PCT

(10) International Publication Number
WO 01/80574 A3

(51) International Patent Classification[7]: H04Q 1/10, H05K 7/14

(21) International Application Number: PCT/US01/11494

(22) International Filing Date: 9 April 2001 (09.04.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
09/549,133 13 April 2000 (13.04.2000) US

(71) Applicant: ADC TELECOMMUNICATIONS, INC. [US/US]: 13265 Technology Drive, Eden Prairie, MN 55344-2252 (US).

(72) Inventors: SWAM, Steven, M.: 3024 Marcia Lane, Shakopee, MN 55379 (US). SIT, Eric, K.: 7536 Carnelian Lane, Eden Prairie, MN 55346 (US). MORGENSTERN, Todd, A.; 14840 Oakcrest Circle, Savage, MN 55378 (US).

(74) Agent: BRUESS, Steven, C.; Merchant & Gould P.C., P.O. Box 2903, Minneapolis, MN 55402-0903 (US).

(81) Designated States *(national)*: AE, AG, AL, AM, AT, AT (utility model), AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, CZ (utility model), DE, DE (utility model), DK, DK (utility model), DM, DZ, EE, EE (utility model), ES, FI, FI (utility model), GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (utility model), SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW.

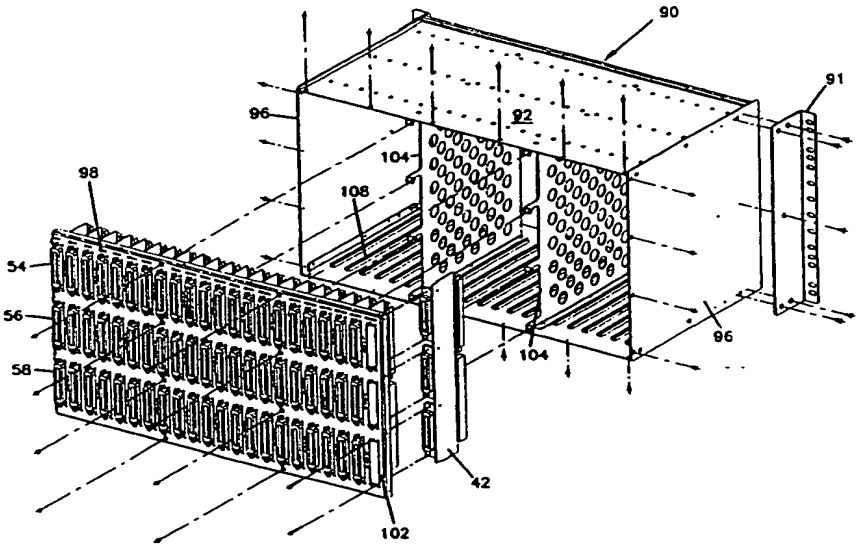
(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii)) for all designations*

[Continued on next page]

(54) Title: SPLITTER ARCHITECTURE FOR A TELECOMMUNICATION SYSTEM



(57) Abstract: An interface card (42) adapted to be mounted at the back plane (46) of a splitter chassis (44). The interface card includes card edge connectors (60, 62) for providing connections with a splitter card. The interface card (44) also includes cable connectors (54, 56, 58) for inputting mixed voice and data, and for outputting data and voice signals. Tracings (76, 84, 88, 80) are provided on the interface card for interconnecting the cable connectors and the card edge connectors. The tracings are configured such that first tracings carrying data signals from the splitter card to the cable connectors do not cross second tracings carrying voice signals form the splitter card to the cable connectors.

WO 01/80574 A3

— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii)) for all designations*

Published:
— *with international search report*
— *with amended claims*

(88) Date of publication of the international search report:
25 April 2002

Date of publication of the amended claims: 23 May 2002

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

AMENDED CLAIMS

[received by the International Bureau on 8 February 2002 (08.02.02); original claim 28 amended; new claims 50-55 added (10 pages)]

1. A telecommunications component comprising:

a circuit board;

a first multi-pair cable connector for inputting twisted pair, mixed data/voice signals to the circuit board;

a second multi-pair cable connector for outputting twisted pair, voice signals from the circuit board;

a third multi-pair cable connector for outputting twisted pair, data signals or mixed data/voice signals from the circuit board;

one or more card edge connectors connected to the circuit board, the one or more card edge connectors including:

a group of normally closed contacts;

a group of normally open contacts, all of the normally open contacts being grouped separately from the normally closed contacts;

first tracings provided on the circuit board for connecting the first multi-pair cable connector to the normally closed contacts;

second tracings provided on the circuit board for connecting the normally closed contacts to the second multi-pair cable connector;

third tracings provided on the circuit board for connecting the normally open contacts to the third multi-pair cable connector; and

the tracings being positioned such that none of the third tracings on the circuit board cross-over any of the first or second tracings.

2. The telecommunications component of claim 1, further comprising a splitter card adapted for connection to the one or more card edge connectors of the circuit board, the splitter card including a plurality of splitters for splitting the mixed data/voice signals into the data signals and the voice signals.

3. The telecommunications component of claim 2, wherein the splitters comprise POTS splitters.

4. The telecommunications component of claim 3, wherein the splitter card includes at least 24 of the POTS splitters.

5. The telecommunications component of claim 1, wherein the one or more card edge connectors include a first card edge connector and a separate second card edge connector, the

AMENDED SHEET (ARTICLE 19)

first card connector including the normally closed contacts and the second card edge connector including the normally open contacts.

6. The telecommunications component of claim 5, further comprising a splitter card adapted for connection to the first and second card edge connectors of the circuit board, the splitter card including a plurality of splitters for splitting the mixed data/voice signals into the data signals and the voice signals.

7. The telecommunications component of claim 6, wherein the splitters comprise POTS splitters.

8. The telecommunications component of claim 7, wherein the splitter card includes at least 24 of the POTS splitters.

9. The telecommunications component of claim 1, further comprising a chassis including a reference back plane at which the first, second and third multi-pair cable connectors are positioned, the circuit board being aligned generally at a perpendicular orientation relative to the reference back plane.

10. The telecommunications component of claim 9, further comprising a splitter card adapted for connection to the one or more card edge connectors of the circuit board, the splitter card including a plurality of splitters for splitting the mixed data/voice signals into the data signals and the voice signals, the splitter card being aligned at a generally parallel orientation relative to the circuit board when the splitter card is connected to the one or more card edge connectors.

11. The telecommunications component of claim 10, wherein the splitters comprise POTS splitters.

12. The telecommunications component of claim 11, wherein the splitter card includes at least 24 of the POTS splitters.

13. The telecommunications component of claim 9, wherein the chassis includes opposing slots, wherein the circuit board is mounted in the slots.

14. The telecommunications component of claim 13, further comprising a splitter card adapted for connection to the one or more card edge connectors of the circuit board, the splitter card including a plurality of splitters for splitting the mixed data/voice signals into the

data signals and the voice signals, the splitter card and the circuit board being mounted in the same opposing slots when the splitter card is connected to the circuit board by the first and second card edge connectors.

15. A telecommunications component comprising:

a chassis defining a reference back plane;

an interface card mounted at the reference back plane of the chassis, the interface card including:

a circuit board positioned at an orientation generally perpendicular with respect to the back plane;

a first multi-pair cable connector positioned at the back plane for inputting twisted pair, mixed data/voice signals to the circuit board;

a second multi-pair cable connector positioned at the back plane for outputting twisted pair, voice signals from the circuit board;

a third multi-pair cable connector positioned at the back plane for outputting twisted pair, data signals or mixed data/voice signals from the circuit board;

one or more card edge connectors connected to the circuit board, the one or more card edge connectors including normally closed contacts and normally open contacts;

first tracings provided on the circuit board for connecting the first multi-pair cable connector to the normally closed contacts;

second tracings provided on the circuit board for connecting the normally closed contacts to the second multi-pair cable connector; and

third tracings provided on the circuit board for connecting the normally open contacts to the third multi-pair cable connector.

16. The telecommunications component of claim 15, further comprising a splitter card adapted for connection to the one or more card edge connectors of the circuit board, the splitter card including a plurality of splitters for splitting the mixed data/voice signals into the data signals and the voice signals, the splitter card being aligned at a generally parallel orientation relative to the circuit board when the splitter card is connected to the one or more card edge connectors.

17. The telecommunications component of claim 16, wherein the splitters comprise POTS splitters.

18. The telecommunications component of claim 17, wherein the splitter card includes at least 24 of the POTS splitters.

19. The telecommunications component of claim 15, wherein the chassis includes opposing slots, wherein the circuit board is mounted in the slots.

20. The telecommunications component of claim 19, further comprising a splitter card adapted for connection to the one or more card edge connectors of the circuit board, the splitter card including a plurality of splitters for splitting the mixed data/voice signals into the data signals and the voice signals, the splitter card and the circuit board being mounted in the same opposing slots when the circuit board and the splitter card are interconnected by the card edge connectors.

21. The telecommunications component of claim 15, wherein a plurality of the interface cards are mounted within the chassis.

22. The telecommunications component of claim 15, wherein the chassis is sized to hold a single one of the interface card.

23. The telecommunications component of claim 15, wherein all of the normally closed contacts are provided on a first card edge connector, and all of the normally open contacts are provided on a separate second card edge connector.

24. The telecommunications component of claim 23, further comprising a splitter card adapted for connection to the first and second card edge connectors, the splitter card including a plurality of splitters for splitting the mixed data/voice signals into the data signals and the voice signals, the splitter card being aligned at a generally parallel orientation relative to the circuit board when the splitter card is connected to the first and second card edge connectors.

25. The telecommunications component of claim 24, wherein the splitters comprise POTS splitters.

26. The telecommunications component of claim 25, wherein the splitter card includes at least 24 of the POTS splitters.

27. The telecommunications component of claim 23, further comprising a splitter card adapted for connection to the first and second card edge connectors, the splitter card including a plurality of splitters for splitting the mixed data/voice signals into the data signals and the voice signals, the splitter card and the circuit board being mounted in a common pair of opposing slots defined by the chassis. connectors.

28. A splitter card comprising:

a circuit board;

a plurality of splitters mounted on the circuit board, each splitter being adapted for receiving a mixed voice and data signals and outputting first signals that are voice only and second signals that are data only or mixed voice and data;

a first card extension adapted to be received in a card edge connector, the first card extension including first contacts for receiving the mixed voice and data signals and second contacts for outputting the first signals;

a second card extension adapted to be received in a card edge connector, the first card extension including third contacts for outputting the second signals;

first tracings for transmitting the mixed voice and data signals from the first contacts to the splitters;

second tracings for transmitting the first signals from the splitters to the second contacts;

third tracings for transmitting the second signals from the splitters to the third contacts; and

all of the first and second contacts being located at the first extension and all of the third contacts being located at the second extension, wherein the first and second contacts are grouped together at a location separate from the third contacts.

29. The splitter card of claim 28, wherein 24 of the splitters are provided on the circuit board.

30. A telecommunications component comprising:

a circuit board;

a multi-pair line connector for inputting twisted pair, mixed data/voice signals to the circuit board;

a multi-pair voice connector for outputting twisted pair, voice signals from the circuit board;

a multi-pair data connector for outputting twisted pair, data signals or mixed data/voice signals from the circuit board;

one or more card edge connectors connected to the circuit board, the one or more card edge connectors including:

a first card edge connector having exclusively normally closed contacts;

a second card edge connector having exclusively normally open contacts;

first conductive pathways provided on the circuit board for connecting the line connector to the normally closed contacts;

second conductive pathways provided on the circuit board for connecting the normally closed contacts to the voice connector; and

third conductive pathways provided on the circuit board for connecting the normally open contacts to the data connector.

31. The telecommunications component of claim 30, wherein the conductive pathways are positioned such that none of the third conductive pathways on the circuit board cross-over any of the first or second conductive pathways.

32. A telecommunications chassis assembly comprising:

a chassis defining a reference back plane;

one or more printed circuit boards positioned adjacent the reference back plane;

a plurality of multi-pair line connectors for inputting twisted pair, mixed data/voice signals to the one or more circuit boards;

a plurality of multi-pair voice connectors for outputting twisted pair, voice signals from the one or more circuit boards;

a plurality of multi-pair data connectors for outputting twisted pair, data signals or mixed data/voice signals from the one or more circuit boards;

a first row of first card edge connectors positioned within the chassis, the first card edge connectors having exclusively normally closed contacts;

a second row of second card edge connectors positioned within the chassis, the second card edge connectors having exclusively normally open contacts;

the line and voice connectors being electrically connected by the one or more circuit boards exclusively to the first row of card edge connectors; and

the data connectors being electrically connected by the one or more circuit boards exclusively to the second row of card edge connectors.

33. The telecommunications chassis assembly of claim 32, wherein the first and second rows are horizontal rows.

34. A telecommunications chassis assembly comprising:

a chassis defining a reference back plane;

one or more printed circuit boards positioned adjacent the reference back plane;

a plurality of multi-pair line connectors for inputting twisted pair, mixed data/voice signals to the one or more circuit boards;

a plurality of multi-pair voice connectors for outputting twisted pair, voice signals from the one or more circuit boards;

a plurality of multi-pair data connectors for outputting twisted pair, data signals or mixed data/voice signals from the one or more circuit boards;

a first array of card edge connectors positioned within the chassis;

a second array of card edge connectors positioned within the chassis;

the line and voice connectors being electrically connected by the one or more circuit boards exclusively to the first array of card edge connectors; and

the data connectors being electrically connected by the one or more circuit boards exclusively to the second array of card edge connectors.

35. The telecommunications chassis assembly of claim 34, wherein the first and second arrays are separate rows.

36. A telecommunications component comprising:

a chassis defining a reference back plane;

an interface card mounted at the reference back plane of the chassis, the interface card including:

a circuit board positioned at an orientation generally perpendicular with respect to the back plane;

a first cable connector positioned at the back plane for inputting twisted pair, mixed data/voice signals to the circuit board;

a second cable connector positioned at the back plane for outputting twisted pair, voice signals from the circuit board;

a third cable connector positioned at the back plane for outputting twisted pair, data signals or mixed data/voice signals from the circuit board; and

one or more card edge connectors connected to the circuit board, the one or more card edge connectors including contacts electrically connected to the cable connectors by the circuit board.

37. The telecommunications component of claim 36, wherein the contacts of the one or more card edge connectors include normally closed contacts electrically connected to the first and second cable connectors.

AMENDED SHEET (ARTICLE 19)

38. The telecommunications component of claim 36, wherein a plurality of the interface cards are mounted at the reference back plane of the chassis, the plurality of interface cards having circuit boards oriented generally perpendicular with respect to the reference back plane.

39. The telecommunications component of claim 38, wherein the plurality of interface cards include 24 generally parallel interface cards.

40. The telecommunications component of claim 36, further comprising a splitter card mounted in the chassis and electrically connected to the card edge connector of the interface card.

41. The telecommunications component of claim 40, wherein the splitter card and the interface card are generally co-planar.

42. The telecommunications connector of claim 38, further comprising a plurality of splitter cards mounted in the chassis and electrically connected to the card edge connectors of the interface cards.

43. A telecommunications component comprising:

a chassis having a front and a back, the front being adapted for allowing splitter cards to be inserted into the chassis;

an interface card mounted adjacent the back of the chassis, the interface card including:

a circuit board having front and back ends and major side surfaces that extend between front and back ends, the circuit board being oriented such that the major side surfaces extend between the front and back of the chassis with the back end being of the circuit board being positioned adjacent the back of the chassis;

first, second and third cable connectors connected to the circuit board adjacent the back end of the circuit board; and

one or more card edge connectors connected to the circuit board adjacent the front end of the circuit board, the one or more card edge connectors including contacts electrically connected to the cable connectors by the circuit board.

44. The telecommunications component of claim 43, wherein the contacts of the one or more card edge connectors include normally closed contacts.

45. The telecommunications component of claim 43, wherein a plurality of the interface cards are mounted at the back of the chassis, the plurality of interface cards having circuit boards oriented generally parallel relative to one another.

46. The telecommunications component of claim 45, wherein the plurality of interface cards include 24 generally parallel interface cards.

47. The telecommunications component of claim 36, further comprising a splitter card mounted in the chassis and electrically connected to the card edge connector of the interface card.

48. The telecommunications component of claim 47, wherein the splitter card and the interface card are generally co-planar.

49. The telecommunications connector of claim 45, further comprising a plurality of splitter cards mounted in the chassis and electrically connected to the card edge connectors of the interface cards.

50. A telecommunications component comprising:

a chassis;

a plurality of interface cards secured to the chassis, the interface cards each including:

a circuit board having first and second opposite ends;

first, second and third cable connectors mounted adjacent the first end of the circuit board; and

one or more card edge connectors mounted adjacent the second end of the circuit board, the one or more card edge connectors including contacts electrically connected to the cable connectors by the circuit board.

51. The component of claim 50, wherein the interface cards are substantially parallel.

52. The component of claim 50, wherein the chassis is sized to hold 24 interface cards.

53. The component of claim 50, further comprising splitter cards mounted in the chassis and electrically connected to the card edge connectors.

54. The component of claim 53, where the interface cards and the splitter cards are substantially co-planar.

55. The component of claim 53, wherein the splitter cards include POTS splitter cards.

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

CORRECTED VERSION

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
25 October 2001 (25.10.2001)

PCT

(10) International Publication Number
WO 01/80574 A3

(51) International Patent Classification[7]: H04Q 1/10, H05K 7/14

(21) International Application Number: PCT/US01/11494

(22) International Filing Date: 9 April 2001 (09.04.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
09/549,133 13 April 2000 (13.04.2000) US

(71) Applicant: ADC TELECOMMUNICATIONS, INC. [US/US]; 13265 Technology Drive, Eden Prairie, MN 55344-2252 (US).

(72) Inventors: SWAM, Steven, M.; 3024 Marcia Lane, Shakopee, MN 55379 (US). SIT, Eric, K.; 7536 Carnelian Lane, Eden Prairie, MN 55346 (US). MORGENSTERN, Todd, A.; 14840 Oakcrest Circle, Savage, MN 55378 (US).

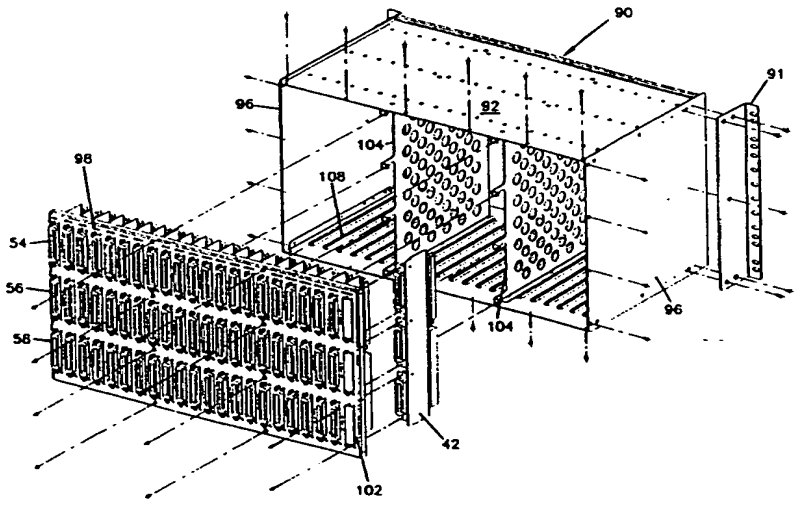
(74) Agent: BRUESS, Steven, C.; Merchant & Gould P.C., P.O. Box 2903, Minneapolis, MN 55402-0903 (US).

(81) Designated States *(national)*: AE, AG, AL, AM, AT, AT (utility model), AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, CZ (utility model), DE, DE (utility model), DK, DK (utility model), DM, DZ, EE, EE (utility model), ES, FI, FI (utility model), GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (utility model), SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE,

[Continued on next page]

(54) Title: SPLITTER ARCHITECTURE FOR A TELECOMMUNICATION SYSTEM



(57) Abstract: An interface card (42) adapted to be mounted at the back plane (46) of a splitter chassis (44). The interface card includes card edge connectors (60, 62) for providing connections with a splitter card. The interface card (44) also includes cable connectors (54, 56, 58) for inputting mixed voice and data, and for outputting data and voice signals. Tracings (76, 84, 88, 80) are provided on the interface card for interconnecting the cable connectors and the card edge connectors. The tracings are configured such that first tracings carrying data signals from the splitter card to the cable connectors do not cross second tracings carrying voice signals form the splitter card to the cable connectors.

WO 01/80574 A3

IT, LU, MC, NL, PT, SE, TR). OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii)) for all designations*

— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii)) for all designations*

Published:

— *with international search report*

— *with amended claims*

(88) Date of publication of the international search report: 25 April 2002

Date of publication of the amended claims: 23 May 2002

(48) Date of publication of this corrected version: 20 June 2002

(15) Information about Correction: see PCT Gazette No. 25/2002 of 20 June 2002, Section II

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

SPLITTER ARCHITECTURE FOR A TELECOMMUNICATIONS SYSTEM

This application is being filed as a PCT International Patent Application in the name of ADC Telecommunications, Inc., a U.S. national corporation, designating all countries except the US, on 09 April 2001.

Background of the Invention

Telecommunications systems commonly include cables containing bundles of twisted pairs of conductors for transmitting telecommunications signals (e.g., voice only signals, data only signals, and combined/mixed voice and data signals, etc.). In these systems, mating connectors (e.g., 25 pair Telco or Amp connectors) are used to couple the cables to telecommunications equipment for processing. In a twisted pair telephone carrier system servicing residential and/or businesses, the system may include an MDF (Main Distribution Frame), a POTS (Plain Old Telephone Service) splitter for separating voice and date signals, and a DSLAM (Digital Subscriber Line Access Multi-Plexer). For most systems, it is desirable to maximize the splitter densities. Other important considerations include scalability, serviceability, reduction of cross-talk, ease of manufacture and cost.

Summary of the Invention

One aspect of the present invention relates to a splitter architecture that accommodates both scalability and serviceability for voice band and ISDN (Integrated Services Digital Network) applications of a digital subscriber line (DSL), while fully supporting lifeline POTS and lifeline ISDN service requirements. By way of example, the DSL's can include asymmetrical digital subscriber lines (ADSL) or very high speed digital subscriber lines (VDSL).

Another aspect of the present invention relates to a telecommunications system capable of providing increased splitter densities.

Still another aspect of the present invention relates to a telecommunications system including a splitter chassis having a back plane, and back plane interface cards mounted at generally perpendicular orientations relative to the back plane. The perpendicular orientation of the back plane interface cards provides for improved splitter densities, and also improves scalability by allowing the same type of back plane interface cards to be used with chassis of different sizes by merely varying the number of interface cards mounted within the chassis.

Still another aspect of the present invention relates to a back plane interface card including card edge connectors for providing connections with a splitter card. The interface card also includes cable connectors for inputting mixed

voice and data, and for outputting data signals and voice signals. Tracings are provided on the interface card for interconnecting the cable connectors and the card edge connectors. The tracings are configured such that first tracings carrying data signals from the splitter card to the cable connectors do not cross second tracings carrying voice signals from the splitter card to the cable connectors.

A further aspect of the present invention relates to a telecommunications component including a circuit board, a first multi-pair cable connector, a second multi-pair cable connector, a third multi-pair connector and one or more card edge connectors. The first multi-pair connector is used to input twisted pair, mixed data/voice signal to the circuit board. The second multi-pair cable connector outputs twisted pair, voice signals from the circuit board. The third multi-pair cable connector outputs twisted pair, data signals from the circuit board. Alternatively, if the signals are to be filtered at a downstream location (e.g., at a DSLAM), the third multi-pair connector can output mixed voice and data signals. The card edge connectors include a group of normally closed contacts, and a group of normally open contacts. All of the normally opened contacts are grouped separately from the normally closed contacts. First tracings are provided on the circuit board for connecting the first multi-pair cable connector to the normally closed contacts. Second tracings are provided on the circuit board for connecting the normally closed contacts to the second multi-pair cable connector. Third tracings are provided on the circuit board for connecting the normally open contacts to the third multi-pair cable connectors. The traces are positioned such that none of the third tracings on the circuit board cross over any of the first or second tracings.

An additional aspect of the present invention relates to a chassis defining a back plane, and a back plane interface card mounted at the back plane of the chassis. The interface card includes a circuit board positioned at an orientation generally perpendicular with respect to the back plane. The interface card also includes a first multi-pair cable connector, a second multi-pair cable connector, a third multi-pair cable connector and one or more card edge connectors. The first multi-pair cable connector is positioned at the back plane for inputting twisted pair, mixed data/voice signals to the circuit board. The second multi-pair cable connector is positioned at the back plane for outputting twisted pair, voice signals from the circuit board. The third multi-pair cable connector is positioned at the back plane for outputting twisted pair, data signals or mixed data/voice signals, from the circuit board. The card edge connectors include normally closed contacts and normally open contacts. First tracings connect the first multi-pair cable connector to the normally closed contacts, second tracings connect the normally closed contacts to

the second multi-pair connector cable, and third tracings connect the normally open contacts to the third multi-pair connector.

Brief Description of the Drawings

Figure 1 is a diagram of a telecommunications system including an MDF, a splitter device, a DSLAM, and a voice switch;

Figure 2 is another telecommunications system including an MDF, a splitter device, a DSLAM, and a voice switch;

Figures 3A and 3B are front and side views of an exemplary twenty-five pair cable connector;

Figure 4A is a schematic illustration of a back plane interface card and a splitter card constructed in accordance with the principles of the present invention, the back plane interface card is shown including normal-through connections for supporting lifeline services;

Figure 4B shows the back plane connector card and the splitter card of Figure 4A interconnected together;

Figures 5A and 5B are plan views of opposite sides of an interface card constructed in accordance with the principles of the present invention, the plan views show a representative tracing pattern;

Figures 5C and 5D show end views of the interface card of Figures 5A and 5B;

Figure 5E shows a multi-layer tracing layout for an interface card having a slightly different tracing pattern than the embodiment of Figures 5A and 5B;

Figure 6 is a schematic depiction of an inventive configuration for a back plane interface card and a splitter card, both the back plane interface card and the splitter card are aligned at a generally perpendicular orientation relative to a chassis back plane;

Figure 7 is a perspective view of a splitter chassis constructed in accordance with the principles of the present invention, an endplate of the chassis has been removed and a splitter card has been slid from the chassis;

Figure 8 is a rear perspective view of the splitter chassis of Figure 7 with the back plane removed;

Figure 9 is a rear view of the loaded splitter chassis of Figure 7;

Figure 10 is a front view of the loaded splitter chassis of Figure 7;

Figure 11 is an exploded view of the splitter chassis of Figure 7 with the splitter cards and the back plane interface cards removed;

Figure 12 is a front perspective view of another chassis constructed in accordance with the principles of the present invention;

Figure 13 is a rear perspective view of the splitter chassis of Figure 12; and

Figure 14 is a front view of the splitter chassis of Figure 12.

While the invention is amenable to various modifications and alternative forms, specifics thereof have been shown by way of example in the drawings and will be described in detail below. It is to be understood, however, that the intention is not to limit the invention to the particular embodiments described. On the contrary, the invention is intended to cover all modifications, equivalents, and alternatives falling within the scope of the invention as defined by the appended claims.

Detailed Description

In the following detailed description, references are made to the accompanying drawings that depict various embodiments in which the invention may be practiced. It is to be understood that other embodiments may be utilized, and structural and functional changes may be made without departing from the scope of the present invention.

Referring now to Figure 1, a telecommunications system 10 is shown including an arrangement of equipment. The system 10 is representative of a telephone carrier's system for transmitting voice and data to residences and businesses. A main distribution frame (MDF) 12 is linked to a splitter device 16 (e.g., a card including POTS splitter circuits or ISDN splitter circuits). The MDF 12 is also linked to one or more DSLAM modules 18, and a voice switch 19 (e.g., a switch equipped with POTS interface line cards or ISDN interface line cards).

In use of the system 10, the splitter device 16 receives a mixed voice and data signal from the MDF 12. The splitter device 16 splits the mixed signal into split signals, and then filters the split signals. For example, one of the split signals can be filtered to provide a voice only signal (i.e., the high frequency data portion of the signal is filtered out), while the other split signal can be filtered to provide a data only signal (i.e., the low frequency voice portion of the signal is filtered out). The data only signals are passed from the splitter device 16 to the DSLAM 18. The voice only signals are passed from the splitter device 16 to the MDF 12 for transmission to the voice switch 19.

Figure 2 shows a similar telecommunications system 10' having the same components as those described with respect to the telecommunications system

10' of Figure 1. However, in the embodiment of Figure 2, voice signals are transmitted directly from the splitter device 16 to the voice switch 19.

Referring still to Figs. 1 and 2, the MDF 12, the POTS splitter device 16, the DSLAM 18 and the voice switch 19 are typically interconnected by cables 21. The cables 21 preferably each include multiple pairs of conductors for transmitting separate twisted pair signals. By way of example, the cables 21 can comprise 25 pair cables (i.e., cables each containing 25 pairs of wire conductors for transmitting 25 separate twisted pair signals). Multi-pair connectors are used to provide interconnections between the cables 21 and the components of the telecommunications system 10. For example, multi-pair connectors are typically provided at the ends of the cables 21. The multi-pair connectors at the ends of the cables 21 are commonly coupled to corresponding multi-pair cable connectors mounted at the equipment to provide connections thereinbetween.

An exemplary multi-pair cable connector 20 is shown in Figures 3A and 3B. The depicted connector 20 is a conventional connector such as a Telco or Amp connector. Preferably, the connector 20 is adapted for use with a 25 pair cable. Thus, the conductor 20 preferably includes 25 pairs of conductors 28. For clarity, only two of the pairs of conductors 28 are shown in Figures 3A and 3B.

The connector 20 includes a first end 26 defining a receptacle 27 sized for receiving a portion of a mating connector (not shown) connected at the end of a cable. The pairs of conductors 28 are positioned within the receptacle 27, and are adapted to contact corresponding conductor pairs of the mating connector. The conductors 28 extend through the connector 20 from the first end 26 to a second end 30. Portions of the conductors 28 located at the second end 30 are used to provide connections to conductor pairs of cables, wires, circuit boards, equipment, etc.

The splitter 16 of Figs. 1 and 2 can be arranged in any number of known configurations. One known splitter configuration includes a chassis having a back plane. An interface card is mounted at the back plane. The interface card includes circuit board that is parallel to the back plane of the chassis. An array of cable connectors mounted on the circuit board. The array of cable connectors includes cable connectors for inputting mixed data/voice signals to the circuit board, cable connectors for outputting voice signals, and cable connectors for outputting data signals from the circuit board. Multiple sets of card edge connectors are provided on the circuit board for allowing multiple splitter cards to interface with the circuit board. The card edge connectors include a number of normal-through connections for providing full support of lifeline POTS and lifeline ISDN services. A plurality of tracings interconnect the array of cable connectors to the sets of card edge connectors. The tracings are arranged such that first tracings carrying data

signals from the splitter cards cross over second tracings carrying voice signals from the splitter cards.

The above described configuration is problematic for a number of reasons. For example, the described crossing over of tracings may increase the cross talk that occurs at the back plane. Also, the described crossing over of tracings requires the circuit board to have a relatively large number of layers thereby increasing the manufacturing costs associated with the circuit board. Further, the configuration of the back plane interface card is not readily scalable because the size of the back plane circuit board will often need to be varied to be used with chassis of different sizes.

Figures 4A and 4B schematically illustrate a splitter architecture 40 in accordance with the principles of the present invention. The architecture 40 is particularly useful with telecommunication service options such as asymmetrical digital subscriber lines (ADSL) and very high speed digital subscriber lines (VDSL). While the signals in the schematics are shown traveling in one direction, it will be appreciated that the system is preferably bi-directional.

The architecture 40 includes a back plane interface card 42 adapted to couple with a splitter card 44. The interface card 42 is preferably mounted at a back plane 46 of a splitter chassis or housing, and includes a circuit board 48 adapted to align at a generally perpendicular angle relative to the back plane 46. The circuit board 48 includes a back edge 50 positioned generally at the back plane 46, and a front edge 52 that is forwardly offset from the back plane 46. First, second and third multi-pair cable connectors 54, 56, and 58 are mounted at the back edge 50, and first and second card edge connectors 60 and 62 are mounted at the front edge 52. The first cable connector 54 (i.e., a LINE connector as labeled in Figure 8) is adapted for inputting twisted pair, mixed data/voice signals to the interface card 42. The second and third cable connectors 56 are used to respectively output twisted pair, voice signals and twisted pair data signals from the interface card 42. These connectors can be referred to as POTS (i.e., voice) and DATA Connectors as labeled in Figure 8. The connectors 54-58 can have the same configuration as the connector shown in Figures 3A and 3B. Referring to Figure 5D, a few representative conductors 28 are shown within the connectors 54-56.

The first and second card edge connectors 60 and 62 are used to provide a connection between the interface card 42 and the splitter card 44. For example, the splitter card 44 includes first and second card edge portions 64 and 66 that are respectively received within the first and second card edge connectors 60 and 62. The card edge portion 64 includes a pair of contacts 68b (e.g., contact pads) on one side of the splitter card 44, and another pair of contacts 70b (e.g., contact

pads) on the other side of the splitter card 44. When the first card edge portion 64 is inserted within the first card edge connector 60, the contacts 68b and 70b engage respective contacts 68a and 70a of the first card edge connector 60. The contacts 68a and 70a, best shown in Figure 5C, are preferably spring contacts that normally engage one another (i.e., the contacts are normally closed). Figure 5C schematically shows a few representative contacts 68a and 70a. When the first card edge portion 64 is inserted within the first card edge connector 60, the contacts 68a and 70a are forced apart and placed into engagement with the contacts 68b and 70b of the splitter card to provide a connection thereinbetween.

Referring again to Figures 4A and 4B, the second card edge portion 66 of the splitter card 44 includes contacts 72 (e.g., contact pads) for providing a connection with the second card edge connector 62. For example, when the second card edge portion 66 is inserted into the second card edge connector 62, the contacts 72 engage respective contacts 74 provided at the second card edge connector 62 to provide a connection thereinbetween. The contacts 74 are preferably normally open (i.e., no signals are passed through the contacts 74 unless the splitter card 44 is coupled to the interface card 42). Figure 5C schematically shows a few representative few contacts 74. As shown in Figure 5C, the contacts 74 include two groups separated by a gap sized for receiving the card edge portion 66. Thus, the groups of contacts 74 are adapted for engaging contacts 72 located on opposite sides of the splitter card.

For clarity purposes, only one twisted pair circuit for the splitter architecture is shown in Figures 4A and 4B. Thus, only single pairs of the contacts 68a, 68b, 70a, 70b, 72 and 74 are shown. However, it will be appreciated that the actual number of contacts provided will be dependent upon the capacity of the connectors 54, 56, and 58; and the number of splitters provided at the splitter card 44. For example, if the cable connectors 54-56 and 58 comprise conventional 25 pair connectors, 24 separate pairs of the contacts 68a, 68b, 70a, 70b, 72 and 74 are preferably provided. In such a case, the twenty fifth pair of conductors in the cable connectors is preferably grounded or inactive. Thus, in such an embodiment, the splitter architecture 40 has the capacity to process 24 separate twisted pair signals. Of course, the capacity of the splitter architecture 40 can be varied. For example, in certain embodiments it may be desirable to provide more or fewer splitters at the splitter card 44 (e.g., any number of splitters can be provided such as 8, 24, 48, 96, etc.). Thus, the number of separate circuit paths provided by the splitter architecture 40 can be varied accordingly.

With respect to the splitter card 44, it is preferred for all of the contacts 68b and 70b to be grouped separately from the contacts 72. For example,

all of the contacts 68b and 70b of the splitter card are preferably provided on the first card edge portion 64, while all of the contacts 72 of the splitter card are preferably provided at the second card edge portion 66. In a card with 24 splitters, 48 of the contacts 72 can be provided at the second card edge portion 66, and 48 of each of the contacts 68b and 70b can be provided at the first card edge portion 64.

Referring still to Figures 4A and 4B, the cable connector 54 is connected to the pair of contacts 68a by first tracings 76; the pair of contacts 70a is connected to cable connector 56 by second tracings 78; and the pair of contacts 74 is connected to cable connector 58 by third tracings 80. Once again, for clarity and ease of explanation, the circuit pathway for only a single twisted pair signal has been illustrated in Figures 4A and 4B.

Figures 5A-5D show the back plane interface card 42 equipped with 24 separate circuits capable of handling 24 different twisted pair signals. In the embodiment of Figures 5A-5D, all of the normally closed contacts 68a and 70a are provided at the first card edge connector 60, and all of the normally open contacts 74 are provided at card edge connector 62. Thus, the normally closed contacts 68a and 70a are grouped separately from the normally open contacts 74. This particular configuration is advantageous because a more simplified tracing layout can be used. For example, because the normally closed contacts 68a and 70a are grouped separately from the normally open contacts 74, none of the third tracings 80 are required to cross over any of the first or second tracings 76 and 78. This helps reduce manufacturing costs by reducing the number of layers required to manufacture the circuit board 48. Additionally, the reduction in crossing of the tracings may assist in reducing cross talk at the back plane 46.

Figure 5E shows a multi-layer view of another interface card 42' constructed in accordance with the principles of the present invention. The card has a similar construction as the card 42 shown in Figures 5A-5D. For example, both cards include cable connectors 54-56, as well as card edge connectors 60 and 62. Also, card 42' has tracings 76', 78' and 80' that serve the same functions as tracings 76, 78 and 80 of the card 42; but are arranged in a slightly different pattern. As previously described with respect to tracings 76-80, tracings 76', 78' and 80' are preferably configured such that none of tracings 80' cross over any of tracings 76' and 78'.

As shown in Figures 5A-5E, the normally open and closed contacts are grouped separately by placing such contacts on separate connectors. It will be appreciated that alternative grouping techniques can also be used. For example, the normally open and closed contacts can be separately grouped (i.e., not mixed or alternated) on a common connector. In one embodiment, all of the contacts can be

grouped separately on a single connector. Additionally, for some applications, it may be desirable to use more than two connectors. For example, the group of normally closed connectors could be split between two connectors and the open contacts could be provided on a third connector.

Referring back to Figures 4A and 4B, the splitter card 44 includes a plurality of splitters 82 (e.g., 24 splitters) The contacts 68b, 70b and 72 are shown connected to one of the splitters 82 by tracings. For example, tracings 84 connect the contacts 68b to the splitter 82, tracings 86 connect the contacts 70b to the splitter 82, and tracings 88 connect the contacts 72 to the splitter 82. While not shown for clarity purposes, it will be appreciated that similar contacts and tracings are provided for each of the twenty four splitters 82 shown in Figures 4A and 4B.

The splitters 82 can have a number of different configurations. For example, the splitters 82 can comprise POTS splitter circuits. A conventional POTS circuit functions to split a composite signal (i.e., a mixed voice/data signal) into two composite signals. One of the split composite signals is typically passed through one or more low pass filters capable of passing the relatively lower frequency voice content of the composite signal (e.g., less than about 4 kHz) and rejecting the composite signal content above the voice band (e.g., 30 kHz and above). The other split composite signal can be passed through a high pass filter that passes the composite signal content associated with the data band (e.g., about 30 kHz and above), and rejects the relatively lower frequency voice content of the composite signal. Alternatively, the other split signal can be unfiltered such that the signal remains a composite signal. For such an embodiment, it is assumed that the DSLAM or other digital multi-plexer that ultimately receives the composite signal will provide any required high-pass filter elements to remove the relatively low frequency voice signal content of the composite signal. It will further be appreciated that ISDN filter circuits could also be used.

Figures 4A and 4B show two modes of operation for the back plane interface card. Figure 4A shows the back plane interface card 42 in a normally closed mode in which the interface card 42 is not connected to the splitter card 44. In such a mode, an analog voice signal (e.g., from an MDF) is inputted to the interface card 42 through connector 54. Once at the interface card 42, the voice signal is transmitted through the first tracings 76 to contact 68a. Because the splitter card 44 is not connected to the interface card 42, the contacts 68a and 70a are closed. Thus, the voice signal is transmitted through the contacts 68a and 70a to the second tracings 78. From the second tracings 78, the voice signal is transmitted through connector 56 and is outputted to another piece of equipment (e.g., an MDF or

switch). In this manner, the normally closed contacts 68a and 70a at the card edge connector 60 fully support lifeline POTS and lifeline ISDN services.

Figure 4B shows the splitter card 44 connected to interface card 42. When the splitter card 44 is connected to the interface card 42, the normally closed contacts 68a, 70a are opened and placed into respective engagement with contacts 68b and 70b of the splitter card 44. Also, contacts 74 of the second card edge connector 62 are concurrently closed (i.e., the contacts 74 are placed into engagement with contacts 72 of the splitter card 44). Thus, a composite signal inputted through connector 54 will be transmitted from cable connector 54 to the splitter 82 via tracings 76 and 84. At the splitter 82, the composite signal is preferably split and filtered such that a voice only signal is transmitted through tracings 86, and a data only signal is transmitted through tracings 88. The voice only signal is transmitted from tracings 86 through contacts 70b and 70a to tracings 78. From tracings 78, the voice only signal is outputted from cable connector 56 to a piece of equipment (e.g., an MDF or switch). The data only signal is transmitted through contacts 72 and 74 to tracings 80. From tracings 80, the data only signal is output through connector 58 to a piece of equipment (e.g., a DSLAM).

Figure 6 is a schematic illustration showing the relative orientations between the back plane interface card 42 and the splitter card 44. As shown, when the splitter card 44 is connected to the interface card 42, the two cards are aligned generally parallel with respect to one another. Thus, as so positioned, both of the cards 42 and 44 are aligned perpendicular relative to the back plane 46 of the chassis. Such a configuration has been found to assist in greatly increasing the splitter density of a given chassis. Such a configuration also improves scalability by allowing the signal sized unifaced cards 42 to be used with chassis of different sizes. Further flexibility can be provided by either mounting the back plane interface cards 42 in a side by side relationship within a chassis, or by stacking the interface cards 42 one on top of the other within a chassis.

Figure 7 illustrates a splitter chassis 90 constructed in accordance with the principles of the present invention. The chassis 90 is generally rectangular and includes a top side 92 positioned opposite from a bottom side 94. End plates 96 are provided for enclosing opposite ends of the chassis 90. A back plane plate 98 (as shown in Figure 8) defines a back plane of the chassis 90, and a front side 100 of the chassis 90 is generally open. The chassis 90 also includes mounting brackets 91 (shown in Figure 8) for connecting the chassis 90 to a structure such as a rack.

As best shown in Figure 8, a plurality of the back plane interface cards 42 are preferably secured to the back plane plate 98 by conventional techniques (e.g., fasteners such as bolts or screws). The back plane plate 98 defines

multiple columns of vertically spaced apart openings 102 sized for receiving the cable connectors 54, 56 and 58 of the interface cards 42. When the interface cards 42 are connected to the back plane plate 98, the connectors define an array of connectors as shown in Figure 9.

Referring to Figure 11, the chassis 90 includes intermediate dividers 104 that provide additional structural rigidity to the chassis 90. The chassis 90 also includes top and bottom tracks 106 and 108 respectively secured to the top side 92 and the bottom side 94 of the chassis 90. The top and the bottom tracks 106 and 108 oppose one another and define elongated slots that extend between the front and back sides of the chassis 90. As shown in Figure 7, the splitter cards 44 are mounted within the chassis 90 by sliding the splitter cards 44 through the open front side 100 into the tracks 106 and 108. Preferably, top and bottom ends of the splitter cards 44 are respectively received within the upper and lower tracks 106 and 108. In this manner, the tracks function to hold the splitter cards in a parallel, slightly spaced apart relation relative to one another. Front latches 110 on the splitter cards 44 hook into a top slot 112 of the chassis to retain the splitter cards 44 within the chassis 90.

As best shown in Figures 7 and 10, the back plane interface cards 42 are also mounted within the tracks 106 and 108. For example, as shown in Figure 10, top and bottom edges of the interface cards 42 are received within the tracks 106 and 108. In this manner, the tracks 106 and 108 assist in holding the back plane interface cards 42 in a perpendicular relationship relative to the back plane plate 98. The top and bottom tracks 106 and 108 also assist in maintaining a generally uniform spacing between the interface cards 42. Preferably, each back plane interface card 42 is mounted in the same set of tracks as its corresponding splitter card 44. With such a configuration, the tracks 106 and 108 assist in providing registry between the interface cards 42 and the splitter cards 44.

Figures 12-14 illustrate an alternative chassis 90' constructed in accordance with the principles of the present invention. The chassis 90' has a rectangular shape and is sized for receiving a single splitter card 44 and a single back plane interface 42. Similar to the chassis of Figure 7, the chassis 90' includes opposing tracks 106' and 108' for receiving the edges of the splitter card 44 and the interface card 42.

The above specification, examples and data provide a complete description of the manufacture and use of the composition of the invention. Since many embodiments of the invention can be made without departing from the spirit and scope of the invention, the invention resides in the claims hereinafter appended.

WE CLAIM:

1. A telecommunications component comprising:

a circuit board;

a first multi-pair cable connector for inputting twisted pair, mixed data/voice signals to the circuit board;

a second multi-pair cable connector for outputting twisted pair, voice signals from the circuit board;

a third multi-pair cable connector for outputting twisted pair, data signals or mixed data/voice signals from the circuit board;

one or more card edge connectors connected to the circuit board, the one or more card edge connectors including:

a group of normally closed contacts;

a group of normally open contacts, all of the normally open contacts being grouped separately from the normally closed contacts;

first tracings provided on the circuit board for connecting the first multi-pair cable connector to the normally closed contacts;

second tracings provided on the circuit board for connecting the normally closed contacts to the second multi-pair cable connector;

third tracings provided on the circuit board for connecting the normally open contacts to the third multi-pair cable connector; and

the tracings being positioned such that none of the third tracings on the circuit board cross-over any of the first or second tracings.

2. The telecommunications component of claim 1, further comprising a splitter card adapted for connection to the one or more card edge connectors of the circuit board, the splitter card including a plurality of splitters for splitting the mixed data/voice signals into the data signals and the voice signals.

3. The telecommunications component of claim 2, wherein the splitters comprise POTS splitters.

4. The telecommunications component of claim 3, wherein the splitter card includes at least 24 of the POTS splitters.

5. The telecommunications component of claim 1, wherein the one or more card edge connectors include a first card edge connector and a separate second card

edge connector, the first card connector including the normally closed contacts and the second card edge connector including the normally open contacts.

6. The telecommunications component of claim 5, further comprising a splitter card adapted for connection to the first and second card edge connectors of the circuit board, the splitter card including a plurality of splitters for splitting the mixed data/voice signals into the data signals and the voice signals.

7. The telecommunications component of claim 6, wherein the splitters comprise POTS splitters.

8. The telecommunications component of claim 7, wherein the splitter card includes at least 24 of the POTS splitters.

9. The telecommunications component of claim 1, further comprising a chassis including a reference back plane at which the first, second and third multi-pair cable connectors are positioned, the circuit board being aligned generally at a perpendicular orientation relative to the reference back plane.

10. The telecommunications component of claim 9, further comprising a splitter card adapted for connection to the one or more card edge connectors of the circuit board, the splitter card including a plurality of splitters for splitting the mixed data/voice signals into the data signals and the voice signals, the splitter card being aligned at a generally parallel orientation relative to the circuit board when the splitter card is connected to the one or more card edge connectors.

11. The telecommunications component of claim 10, wherein the splitters comprise POTS splitters.

12. The telecommunications component of claim 11, wherein the splitter card includes at least 24 of the POTS splitters.

13. The telecommunications component of claim 9, wherein the chassis includes opposing slots, wherein the circuit board is mounted in the slots.

14. The telecommunications component of claim 13, further comprising a splitter card adapted for connection to the one or more card edge connectors of the circuit board, the splitter card including a plurality of splitters for splitting the mixed

data/voice signals into the data signals and the voice signals, the splitter card and the circuit board being mounted in the same opposing slots when the splitter card is connected to the circuit board by the first and second card edge connectors.

15. A telecommunications component comprising:

a chassis defining a reference back plane;

an interface card mounted at the reference back plane of the chassis, the interface card including:

a circuit board positioned at an orientation generally perpendicular with respect to the back plane;

a first multi-pair cable connector positioned at the back plane for inputting twisted pair, mixed data/voice signals to the circuit board;

a second multi-pair cable connector positioned at the back plane for outputting twisted pair, voice signals from the circuit board;

a third multi-pair cable connector positioned at the back plane for outputting twisted pair, data signals or mixed data/voice signals from the circuit board;

one or more card edge connectors connected to the circuit board, the one or more card edge connectors including normally closed contacts and normally open contacts;

first tracings provided on the circuit board for connecting the first multi-pair cable connector to the normally closed contacts;

second tracings provided on the circuit board for connecting the normally closed contacts to the second multi-pair cable connector; and

third tracings provided on the circuit board for connecting the normally open contacts to the third multi-pair cable connector.

16. The telecommunications component of claim 15, further comprising a splitter card adapted for connection to the one or more card edge connectors of the circuit board, the splitter card including a plurality of splitters for splitting the mixed data/voice signals into the data signals and the voice signals, the splitter card being aligned at a generally parallel orientation relative to the circuit board when the splitter card is connected to the one or more card edge connectors.

17. The telecommunications component of claim 16, wherein the splitters comprise POTS splitters.

18. The telecommunications component of claim 17, wherein the splitter card includes at least 24 of the POTS splitters.

19. The telecommunications component of claim 15, wherein the chassis includes opposing slots, wherein the circuit board is mounted in the slots.

20. The telecommunications component of claim 19, further comprising a splitter card adapted for connection to the one or more card edge connectors of the circuit board, the splitter card including a plurality of splitters for splitting the mixed data/voice signals into the data signals and the voice signals, the splitter card and the circuit board being mounted in the same opposing slots when the circuit board and the splitter card are interconnected by the card edge connectors.

21. The telecommunications component of claim 15, wherein a plurality of the interface cards are mounted within the chassis.

22. The telecommunications component of claim 15, wherein the chassis is sized to hold a single one of the interface card.

23. The telecommunications component of claim 15, wherein all of the normally closed contacts are provided on a first card edge connector, and all of the normally open contacts are provided on a separate second card edge connector.

24. The telecommunications component of claim 23, further comprising a splitter card adapted for connection to the first and second card edge connectors, the splitter card including a plurality of splitters for splitting the mixed data/voice signals into the data signals and the voice signals, the splitter card being aligned at a generally parallel orientation relative to the circuit board when the splitter card is connected to the first and second card edge connectors.

25. The telecommunications component of claim 24, wherein the splitters comprise POTS splitters.

26. The telecommunications component of claim 25, wherein the splitter card includes at least 24 of the POTS splitters.

27. The telecommunications component of claim 23, further comprising a splitter card adapted for connection to the first and second card edge connectors, the splitter

card including a plurality of splitters for splitting the mixed data/voice signals into the data signals and the voice signals, the splitter card and the circuit board being mounted in a common pair of opposing slots defined by the chassis. connectors.

28. A splitter card comprising:

a circuit board;

a plurality of splitters mounted on the circuit board, each splitter being adapted for receiving a mixed voice and data signals and outputting first signals that are voice only and second signals that are data only;

a first card extension adapted to be received in a card edge connector, the first card extension including first contacts for receiving the mixed voice and data signals and second contacts for outputting the first signals;

a second card extension adapted to be received in a card edge connector, the first card extension including third contacts for outputting the second signals;

first tracings for transmitting the mixed voice and data signals from the first contacts to the splitters;

second tracings for transmitting the first signals from the splitters to the second contacts;

third tracings for transmitting the second signals from the splitters to the third contacts; and

all of the first and second contacts being located at the first extension and all of the third contacts being located at the second extension, wherein the first and second contacts are grouped together at a location separate from the third contacts.

29. The splitter card of claim 28, wherein 24 of the splitters are provided on the circuit board.

30. A telecommunications component comprising:

a circuit board;

a multi-pair line connector for inputting twisted pair, mixed data/voice signals to the circuit board;

a multi-pair voice connector for outputting twisted pair, voice signals from the circuit board;

a multi-pair data connector for outputting twisted pair, data signals or mixed data/voice signals from the circuit board;

one or more card edge connectors connected to the circuit board, the one or more card edge connectors including:

a first card edge connector having exclusively normally closed contacts;

a second card edge connector having exclusively normally open contacts;

first conductive pathways provided on the circuit board for connecting the line connector to the normally closed contacts;

second conductive pathways provided on the circuit board for connecting the normally closed contacts to the voice connector; and

third conductive pathways provided on the circuit board for connecting the normally open contacts to the data connector.

31. The telecommunications component of claim 30, wherein the conductive pathways are positioned such that none of the third conductive pathways on the circuit board cross-over any of the first or second conductive pathways.

32. A telecommunications chassis assembly comprising:

a chassis defining a reference back plane;

one or more printed circuit boards positioned adjacent the reference back plane;

a plurality of multi-pair line connectors for inputting twisted pair, mixed data/voice signals to the one or more circuit boards;

a plurality of multi-pair voice connectors for outputting twisted pair, voice signals from the one or more circuit boards;

a plurality of multi-pair data connectors for outputting twisted pair, data signals or mixed data/voice signals from the one or more circuit boards;

a first row of first card edge connectors positioned within the chassis, the first card edge connectors having exclusively normally closed contacts;

a second row of second card edge connectors positioned within the chassis, the second card edge connectors having exclusively normally open contacts;

the line and voice connectors being electrically connected by the one or more circuit boards exclusively to the first row of card edge connectors; and

the data connectors being electrically connected by the one or more circuit boards exclusively to the second row of card edge connectors.

33. The telecommunications chassis assembly of claim 32, wherein the first and second rows are horizontal rows.

34. A telecommunications chassis assembly comprising:

a chassis defining a reference back plane;

one or more printed circuit boards positioned adjacent the reference back plane;

a plurality of multi-pair line connectors for inputting twisted pair, mixed data/voice signals to the one or more circuit boards;

a plurality of multi-pair voice connectors for outputting twisted pair, voice signals from the one or more circuit boards;

a plurality of multi-pair data connectors for outputting twisted pair, data signals or mixed data/voice signals from the one or more circuit boards;

a first array of card edge connectors positioned within the chassis;

a second array of card edge connectors positioned within the chassis;

the line and voice connectors being electrically connected by the one or more circuit boards exclusively to the first array of card edge connectors; and

the data connectors being electrically connected by the one or more circuit boards exclusively to the second array of card edge connectors.

35. The telecommunications chassis assembly of claim 34, wherein the first and second arrays are separate rows.

36. A telecommunications component comprising:

a chassis defining a reference back plane;

an interface card mounted at the reference back plane of the chassis, the interface card including:

a circuit board positioned at an orientation generally perpendicular with respect to the back plane;

a first cable connector positioned at the back plane for inputting twisted pair, mixed data/voice signals to the circuit board;

a second cable connector positioned at the back plane for outputting twisted pair, voice signals from the circuit board;

a third cable connector positioned at the back plane for outputting twisted pair, data signals or mixed data/voice signals from the circuit board; and

one or more card edge connectors connected to the circuit board, the one or more card edge connectors including contacts electrically connected to the cable connectors by the circuit board.

37. The telecommunications component of claim 36, wherein the contacts of the one or more card edge connectors include normally closed contacts electrically connected to the first and second cable connectors.

38. The telecommunications component of claim 36, wherein a plurality of the interface cards are mounted at the reference back plane of the chassis, the plurality of interface cards having circuit boards oriented generally perpendicular with respect to the reference back plane.

39. The telecommunications component of claim 38, wherein the plurality of interface cards include 24 generally parallel interface cards.

40. The telecommunications component of claim 36, further comprising a splitter card mounted in the chassis and electrically connected to the card edge connector of the interface card.

41. The telecommunications component of claim 40, wherein the splitter card and the interface card are generally co-planar.

42. The telecommunications connector of claim 38, further comprising a plurality of splitter cards mounted in the chassis and electrically connected to the card edge connectors of the interface cards.

43. A telecommunications component comprising:

a chassis having a front and a back, the front being adapted for allowing splitter cards to be inserted into the chassis;

an interface card mounted adjacent the back of the chassis, the interface card including:

a circuit board having front and back ends and major side surfaces that extend between front and back ends, the circuit board being oriented such that the major side surfaces extend between the front and back of the chassis with the back end being of the circuit board being positioned adjacent the back of the chassis;

first, second and third cable connectors connected to the circuit board adjacent the back end of the circuit board; and

one or more card edge connectors connected to the circuit board adjacent the front end of the circuit board, the one or more card edge connectors including contacts electrically connected to the cable connectors by the circuit board.

44. The telecommunications component of claim 43, wherein the contacts of the one or more card edge connectors include normally closed contacts.

45. The telecommunications component of claim 43, wherein a plurality of the interface cards are mounted at the back of the chassis, the plurality of interface cards having circuit boards oriented generally parallel relative to one another.

46. The telecommunications component of claim 45, wherein the plurality of interface cards include 24 generally parallel interface cards.

47. The telecommunications component of claim 36, further comprising a splitter card mounted in the chassis and electrically connected to the card edge connector of the interface card.

48. The telecommunications component of claim 47, wherein the splitter card and the interface card are generally co-planar.

49. The telecommunications connector of claim 45, further comprising a plurality of splitter cards mounted in the chassis and electrically connected to the card edge connectors of the interface cards.

AMENDED CLAIMS

[received by the International Bureau on 8 February 2002 (08.02.02);
original claim 28 amended; new claims 50-55 added (10 pages)]

1. A telecommunications component comprising:

a circuit board;

a first multi-pair cable connector for inputting twisted pair, mixed data/voice signals to the circuit board;

a second multi-pair cable connector for outputting twisted pair, voice signals from the circuit board;

a third multi-pair cable connector for outputting twisted pair, data signals or mixed data/voice signals from the circuit board;

one or more card edge connectors connected to the circuit board, the one or more card edge connectors including:

a group of normally closed contacts;

a group of normally open contacts, all of the normally open contacts being grouped separately from the normally closed contacts;

first tracings provided on the circuit board for connecting the first multi-pair cable connector to the normally closed contacts;

second tracings provided on the circuit board for connecting the normally closed contacts to the second multi-pair cable connector;

third tracings provided on the circuit board for connecting the normally open contacts to the third multi-pair cable connector; and

the tracings being positioned such that none of the third tracings on the circuit board cross-over any of the first or second tracings.

2. The telecommunications component of claim 1, further comprising a splitter card adapted for connection to the one or more card edge connectors of the circuit board, the splitter card including a plurality of splitters for splitting the mixed data/voice signals into the data signals and the voice signals.

3. The telecommunications component of claim 2, wherein the splitters comprise POTS splitters.

4. The telecommunications component of claim 3, wherein the splitter card includes at least 24 of the POTS splitters.

5. The telecommunications component of claim 1, wherein the one or more card edge connectors include a first card edge connector and a separate second card edge connector, the

AMENDED SHEET (ARTICLE 19)

first card connector including the normally closed contacts and the second card edge connector including the normally open contacts.

6. The telecommunications component of claim 5, further comprising a splitter card adapted for connection to the first and second card edge connectors of the circuit board, the splitter card including a plurality of splitters for splitting the mixed data/voice signals into the data signals and the voice signals.

7. The telecommunications component of claim 6, wherein the splitters comprise POTS splitters.

8. The telecommunications component of claim 7, wherein the splitter card includes at least 24 of the POTS splitters.

9. The telecommunications component of claim 1, further comprising a chassis including a reference back plane at which the first, second and third multi-pair cable connectors are positioned, the circuit board being aligned generally at a perpendicular orientation relative to the reference back plane.

10. The telecommunications component of claim 9, further comprising a splitter card adapted for connection to the one or more card edge connectors of the circuit board, the splitter card including a plurality of splitters for splitting the mixed data/voice signals into the data signals and the voice signals, the splitter card being aligned at a generally parallel orientation relative to the circuit board when the splitter card is connected to the one or more card edge connectors.

11. The telecommunications component of claim 10, wherein the splitters comprise POTS splitters.

12. The telecommunications component of claim 11, wherein the splitter card includes at least 24 of the POTS splitters.

13. The telecommunications component of claim 9, wherein the chassis includes opposing slots, wherein the circuit board is mounted in the slots.

14. The telecommunications component of claim 13, further comprising a splitter card adapted for connection to the one or more card edge connectors of the circuit board, the splitter card including a plurality of splitters for splitting the mixed data/voice signals into the

data signals and the voice signals, the splitter card and the circuit board being mounted in the same opposing slots when the splitter card is connected to the circuit board by the first and second card edge connectors.

15. A telecommunications component comprising:

a chassis defining a reference back plane;

an interface card mounted at the reference back plane of the chassis, the interface card including:

a circuit board positioned at an orientation generally perpendicular with respect to the back plane;

a first multi-pair cable connector positioned at the back plane for inputting twisted pair, mixed data/voice signals to the circuit board;

a second multi-pair cable connector positioned at the back plane for outputting twisted pair, voice signals from the circuit board;

a third multi-pair cable connector positioned at the back plane for outputting twisted pair, data signals or mixed data/voice signals from the circuit board;

one or more card edge connectors connected to the circuit board, the one or more card edge connectors including normally closed contacts and normally open contacts;

first tracings provided on the circuit board for connecting the first multi-pair cable connector to the normally closed contacts;

second tracings provided on the circuit board for connecting the normally closed contacts to the second multi-pair cable connector; and

third tracings provided on the circuit board for connecting the normally open contacts to the third multi-pair cable connector.

16. The telecommunications component of claim 15, further comprising a splitter card adapted for connection to the one or more card edge connectors of the circuit board, the splitter card including a plurality of splitters for splitting the mixed data/voice signals into the data signals and the voice signals, the splitter card being aligned at a generally parallel orientation relative to the circuit board when the splitter card is connected to the one or more card edge connectors.

17. The telecommunications component of claim 16, wherein the splitters comprise POTS splitters.

18. The telecommunications component of claim 17, wherein the splitter card includes at least 24 of the POTS splitters.

19. The telecommunications component of claim 15, wherein the chassis includes opposing slots, wherein the circuit board is mounted in the slots.

20. The telecommunications component of claim 19, further comprising a splitter card adapted for connection to the one or more card edge connectors of the circuit board, the splitter card including a plurality of splitters for splitting the mixed data/voice signals into the data signals and the voice signals, the splitter card and the circuit board being mounted in the same opposing slots when the circuit board and the splitter card are interconnected by the card edge connectors.

21. The telecommunications component of claim 15, wherein a plurality of the interface cards are mounted within the chassis.

22. The telecommunications component of claim 15, wherein the chassis is sized to hold a single one of the interface card.

23. The telecommunications component of claim 15, wherein all of the normally closed contacts are provided on a first card edge connector, and all of the normally open contacts are provided on a separate second card edge connector.

24. The telecommunications component of claim 23, further comprising a splitter card adapted for connection to the first and second card edge connectors, the splitter card including a plurality of splitters for splitting the mixed data/voice signals into the data signals and the voice signals, the splitter card being aligned at a generally parallel orientation relative to the circuit board when the splitter card is connected to the first and second card edge connectors.

25. The telecommunications component of claim 24, wherein the splitters comprise POTS splitters.

26. The telecommunications component of claim 25, wherein the splitter card includes at least 24 of the POTS splitters.

27. The telecommunications component of claim 23, further comprising a splitter card adapted for connection to the first and second card edge connectors, the splitter card including a plurality of splitters for splitting the mixed data/voice signals into the data signals and the voice signals, the splitter card and the circuit board being mounted in a common pair of opposing slots defined by the chassis. connectors.

28. A splitter card comprising:

a circuit board;

a plurality of splitters mounted on the circuit board, each splitter being adapted for receiving a mixed voice and data signals and outputting first signals that are voice only and second signals that are data only or mixed voice and data;

a first card extension adapted to be received in a card edge connector, the first card extension including first contacts for receiving the mixed voice and data signals and second contacts for outputting the first signals;

a second card extension adapted to be received in a card edge connector, the first card extension including third contacts for outputting the second signals;

first tracings for transmitting the mixed voice and data signals from the first contacts to the splitters;

second tracings for transmitting the first signals from the splitters to the second contacts;

third tracings for transmitting the second signals from the splitters to the third contacts; and

all of the first and second contacts being located at the first extension and all of the third contacts being located at the second extension, wherein the first and second contacts are grouped together at a location separate from the third contacts.

29. The splitter card of claim 28, wherein 24 of the splitters are provided on the circuit board.

30. A telecommunications component comprising:

a circuit board;

a multi-pair line connector for inputting twisted pair, mixed data/voice signals to the circuit board;

a multi-pair voice connector for outputting twisted pair, voice signals from the circuit board;

a multi-pair data connector for outputting twisted pair, data signals or mixed data/voice signals from the circuit board;

one or more card edge connectors connected to the circuit board, the one or more card edge connectors including:

a first card edge connector having exclusively normally closed contacts;

a second card edge connector having exclusively normally open contacts;

first conductive pathways provided on the circuit board for connecting the line connector to the normally closed contacts;

second conductive pathways provided on the circuit board for connecting the normally closed contacts to the voice connector; and

third conductive pathways provided on the circuit board for connecting the normally open contacts to the data connector.

31. The telecommunications component of claim 30, wherein the conductive pathways are positioned such that none of the third conductive pathways on the circuit board cross-over any of the first or second conductive pathways.

32. A telecommunications chassis assembly comprising:

a chassis defining a reference back plane;

one or more printed circuit boards positioned adjacent the reference back plane;

a plurality of multi-pair line connectors for inputting twisted pair, mixed data/voice signals to the one or more circuit boards;

a plurality of multi-pair voice connectors for outputting twisted pair, voice signals from the one or more circuit boards;

a plurality of multi-pair data connectors for outputting twisted pair, data signals or mixed data/voice signals from the one or more circuit boards;

a first row of first card edge connectors positioned within the chassis, the first card edge connectors having exclusively normally closed contacts;

a second row of second card edge connectors positioned within the chassis, the second card edge connectors having exclusively normally open contacts;

the line and voice connectors being electrically connected by the one or more circuit boards exclusively to the first row of card edge connectors; and

the data connectors being electrically connected by the one or more circuit boards exclusively to the second row of card edge connectors.

33. The telecommunications chassis assembly of claim 32, wherein the first and second rows are horizontal rows.

34. A telecommunications chassis assembly comprising:

a chassis defining a reference back plane;

one or more printed circuit boards positioned adjacent the reference back plane;

a plurality of multi-pair line connectors for inputting twisted pair, mixed data/voice signals to the one or more circuit boards;

a plurality of multi-pair voice connectors for outputting twisted pair, voice signals from the one or more circuit boards;

a plurality of multi-pair data connectors for outputting twisted pair, data signals or mixed data/voice signals from the one or more circuit boards;

a first array of card edge connectors positioned within the chassis;

a second array of card edge connectors positioned within the chassis;

the line and voice connectors being electrically connected by the one or more circuit boards exclusively to the first array of card edge connectors; and

the data connectors being electrically connected by the one or more circuit boards exclusively to the second array of card edge connectors.

35. The telecommunications chassis assembly of claim 34, wherein the first and second arrays are separate rows.

36. A telecommunications component comprising:

a chassis defining a reference back plane;

an interface card mounted at the reference back plane of the chassis, the interface card including:

a circuit board positioned at an orientation generally perpendicular with respect to the back plane;

a first cable connector positioned at the back plane for inputting twisted pair, mixed data/voice signals to the circuit board;

a second cable connector positioned at the back plane for outputting twisted pair, voice signals from the circuit board;

a third cable connector positioned at the back plane for outputting twisted pair, data signals or mixed data/voice signals from the circuit board; and

one or more card edge connectors connected to the circuit board, the one or more card edge connectors including contacts electrically connected to the cable connectors by the circuit board.

37. The telecommunications component of claim 36, wherein the contacts of the one or more card edge connectors include normally closed contacts electrically connected to the first and second cable connectors.

AMENDED SHEET (ARTICLE 19)

38. The telecommunications component of claim 36, wherein a plurality of the interface cards are mounted at the reference back plane of the chassis, the plurality of interface cards having circuit boards oriented generally perpendicular with respect to the reference back plane.

39. The telecommunications component of claim 38, wherein the plurality of interface cards include 24 generally parallel interface cards.

40. The telecommunications component of claim 36, further comprising a splitter card mounted in the chassis and electrically connected to the card edge connector of the interface card.

41. The telecommunications component of claim 40, wherein the splitter card and the interface card are generally co-planar.

42. The telecommunications connector of claim 38, further comprising a plurality of splitter cards mounted in the chassis and electrically connected to the card edge connectors of the interface cards.

43. A telecommunications component comprising:

a chassis having a front and a back, the front being adapted for allowing splitter cards to be inserted into the chassis;

an interface card mounted adjacent the back of the chassis, the interface card including:

a circuit board having front and back ends and major side surfaces that extend between front and back ends, the circuit board being oriented such that the major side surfaces extend between the front and back of the chassis with the back end being of the circuit board being positioned adjacent the back of the chassis;

first, second and third cable connectors connected to the circuit board adjacent the back end of the circuit board; and

one or more card edge connectors connected to the circuit board adjacent the front end of the circuit board, the one or more card edge connectors including contacts electrically connected to the cable connectors by the circuit board.

44. The telecommunications component of claim 43, wherein the contacts of the one or more card edge connectors include normally closed contacts.

45. The telecommunications component of claim 43, wherein a plurality of the interface cards are mounted at the back of the chassis, the plurality of interface cards having circuit boards oriented generally parallel relative to one another.

46. The telecommunications component of claim 45, wherein the plurality of interface cards include 24 generally parallel interface cards.

47. The telecommunications component of claim 36, further comprising a splitter card mounted in the chassis and electrically connected to the card edge connector of the interface card.

48. The telecommunications component of claim 47, wherein the splitter card and the interface card are generally co-planar.

49. The telecommunications connector of claim 45, further comprising a plurality of splitter cards mounted in the chassis and electrically connected to the card edge connectors of the interface cards.

50. A telecommunications component comprising:

a chassis;

a plurality of interface cards secured to the chassis, the interface cards each including:

a circuit board having first and second opposite ends;

first, second and third cable connectors mounted adjacent the first end of the circuit board; and

one or more card edge connectors mounted adjacent the second end of the circuit board, the one or more card edge connectors including contacts electrically connected to the cable connectors by the circuit board.

51. The component of claim 50, wherein the interface cards are substantially parallel.

52. The component of claim 50, wherein the chassis is sized to hold 24 interface cards.

53. The component of claim 50, further comprising splitter cards mounted in the chassis and electrically connected to the card edge connectors.

54. The component of claim 53, where the interface cards and the splitter cards are substantially co-planar.

55. The component of claim 53, wherein the splitter cards include POTS splitter cards.

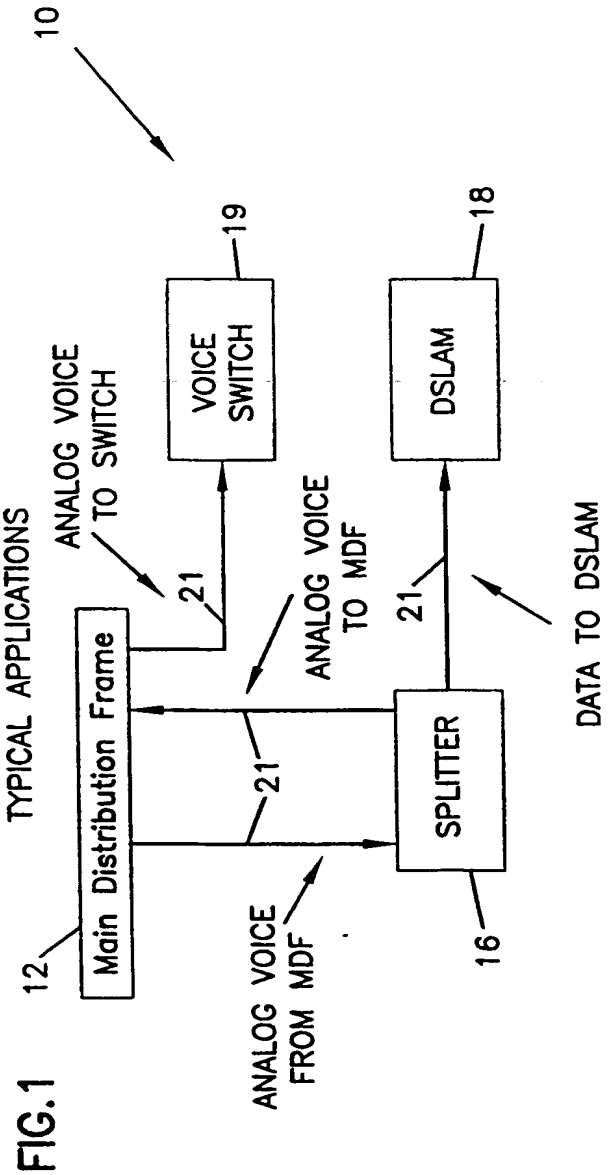

10
TYPICAL APPLICATIONS
ANALOG VOICE TO SWITCH
VOICE SWITCH
19
DSLAM
18
21
ANALOG VOICE TO MDF
21
DATA TO DSLAM
Main Distribution Frame
12
21
SPLITTER
ANALOG VOICE FROM MDF
16

FIG. 1

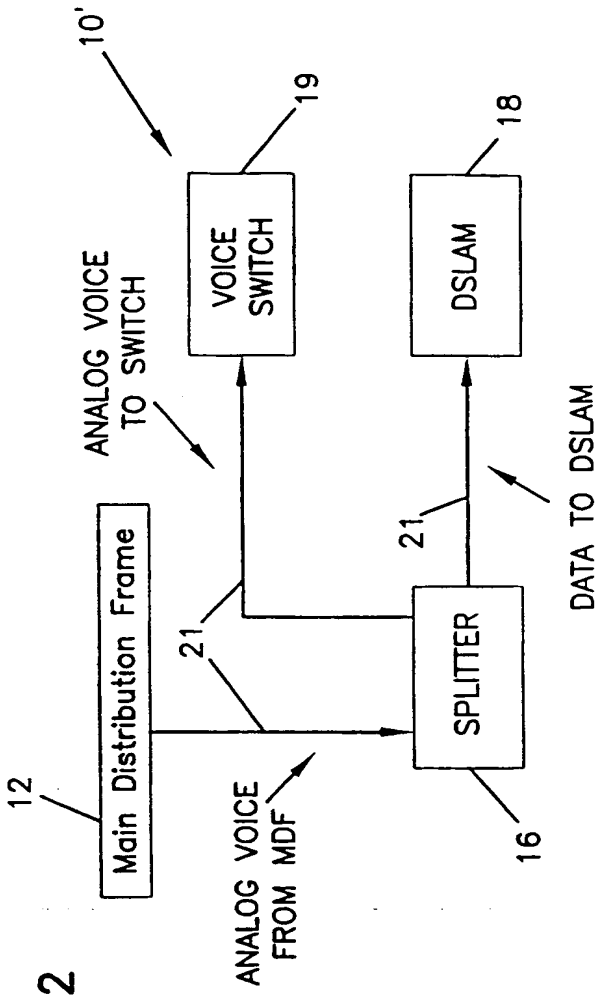

10'
19
VOICE SWITCH
18
DSLAM
ANALOG VOICE TO SWITCH
21
DATA TO DSLAM
Main Distribution Frame
12
21
SPLITTER
ANALOG VOICE FROM MDF
16

FIG. 2

FIG. 3B

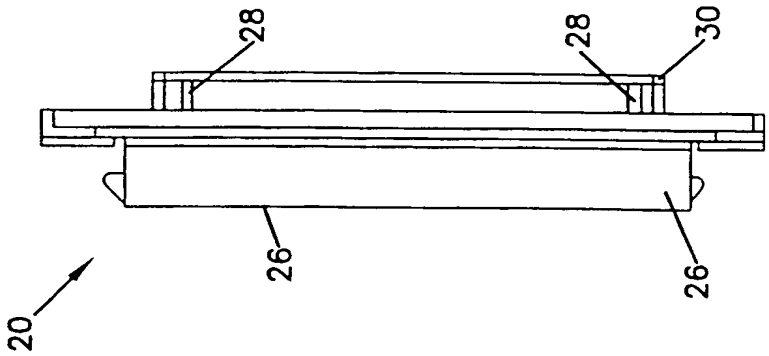
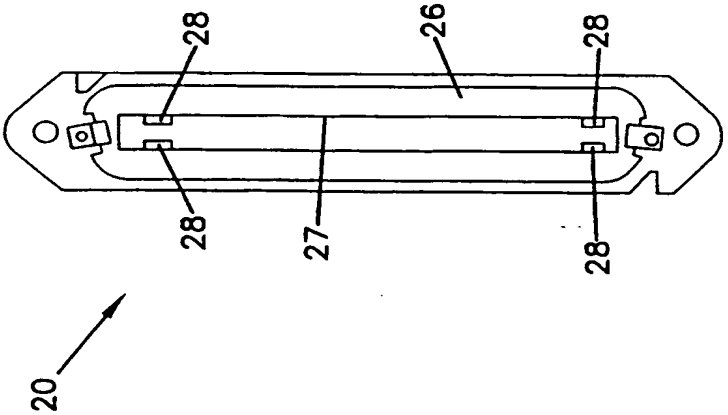


FIG. 3A



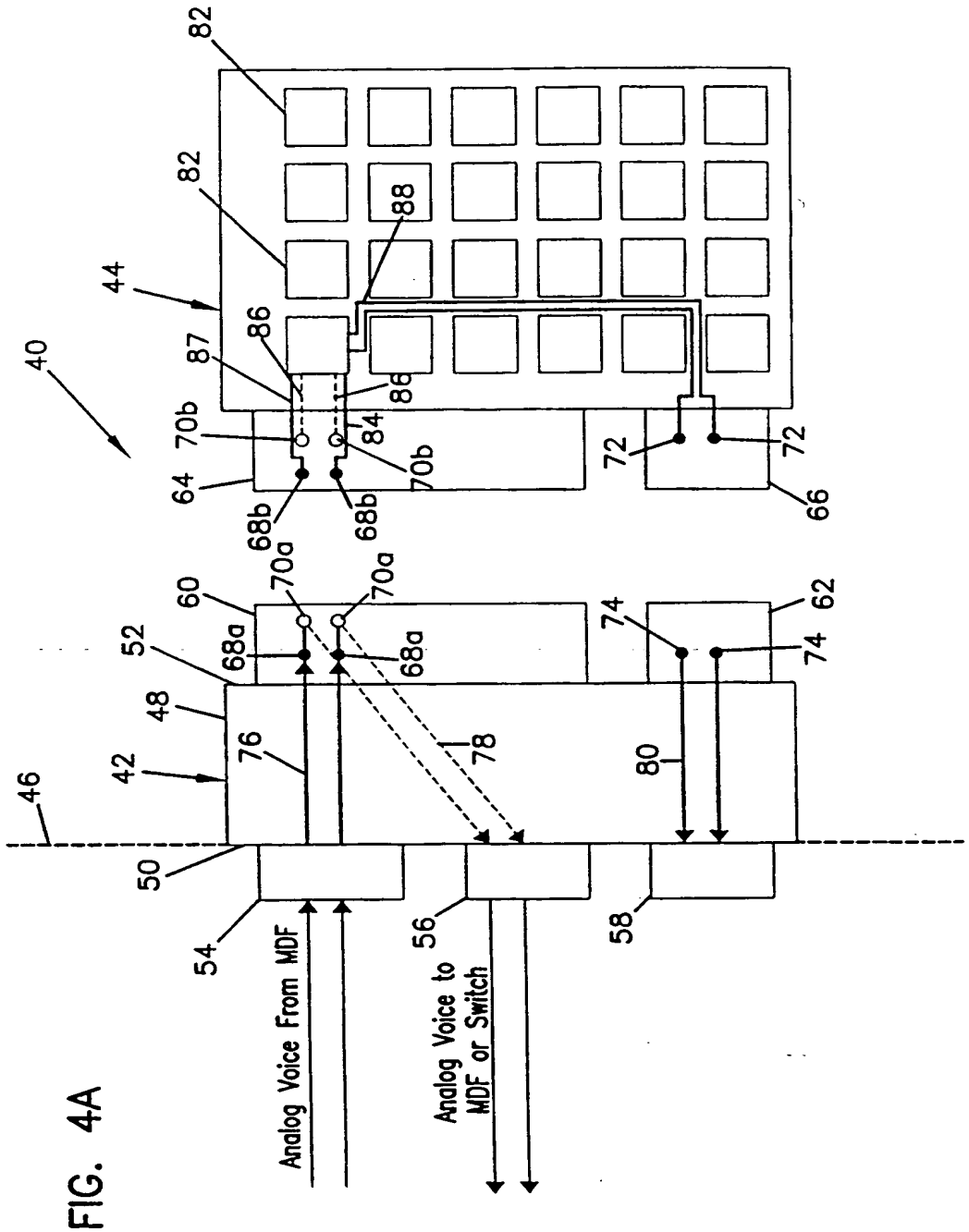
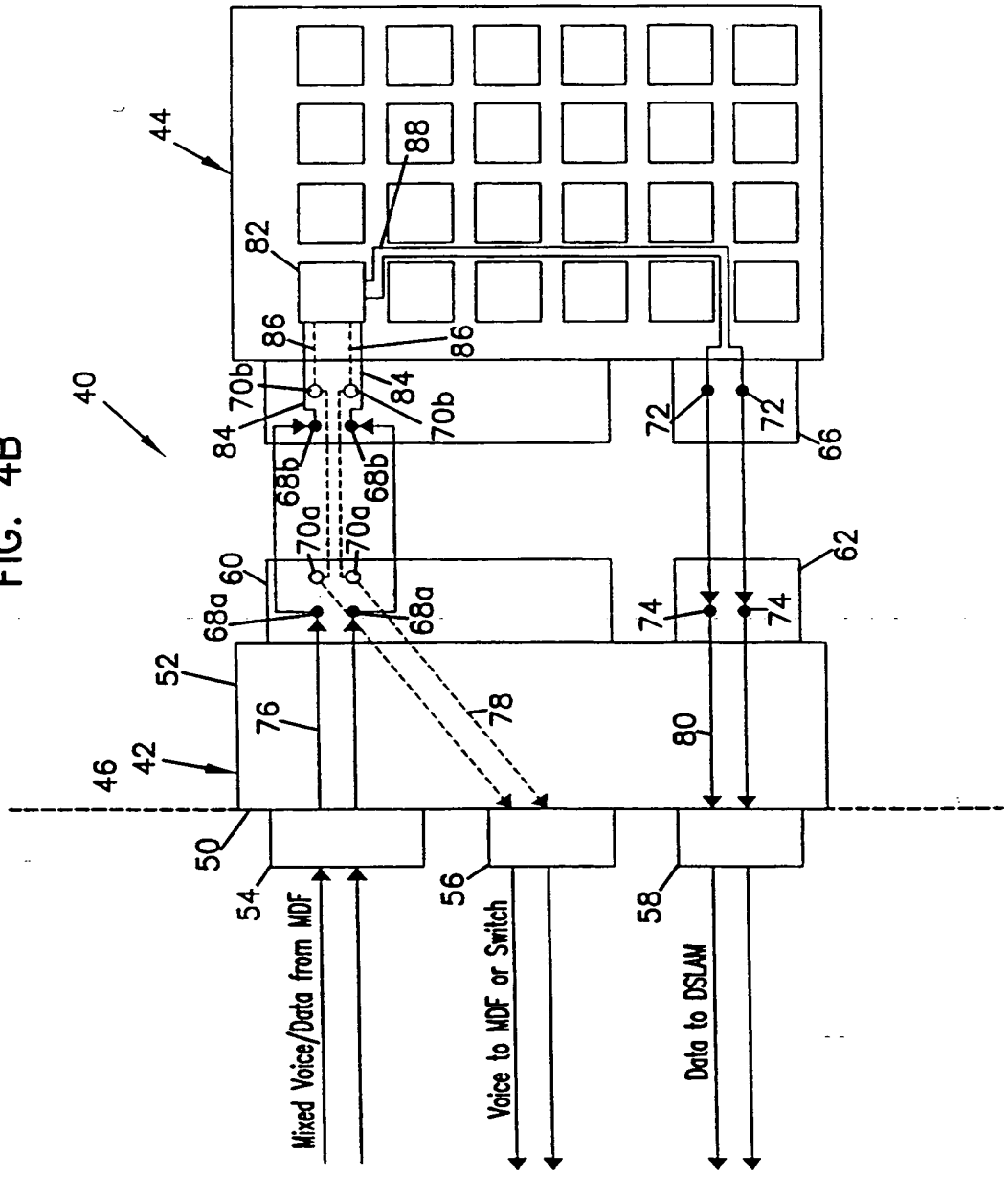


FIG. 4A

FIG. 4B


44
88
82
86
86
40
70b
84
84
70b
72
72
66
68b
68b
70a
70a
60
62
68a
68a
74
74
52
76
78
80
46
42
50
54
56
58
Mixed Voice/Data from MDF
Voice to MDF or Switch
Data to DSLAM

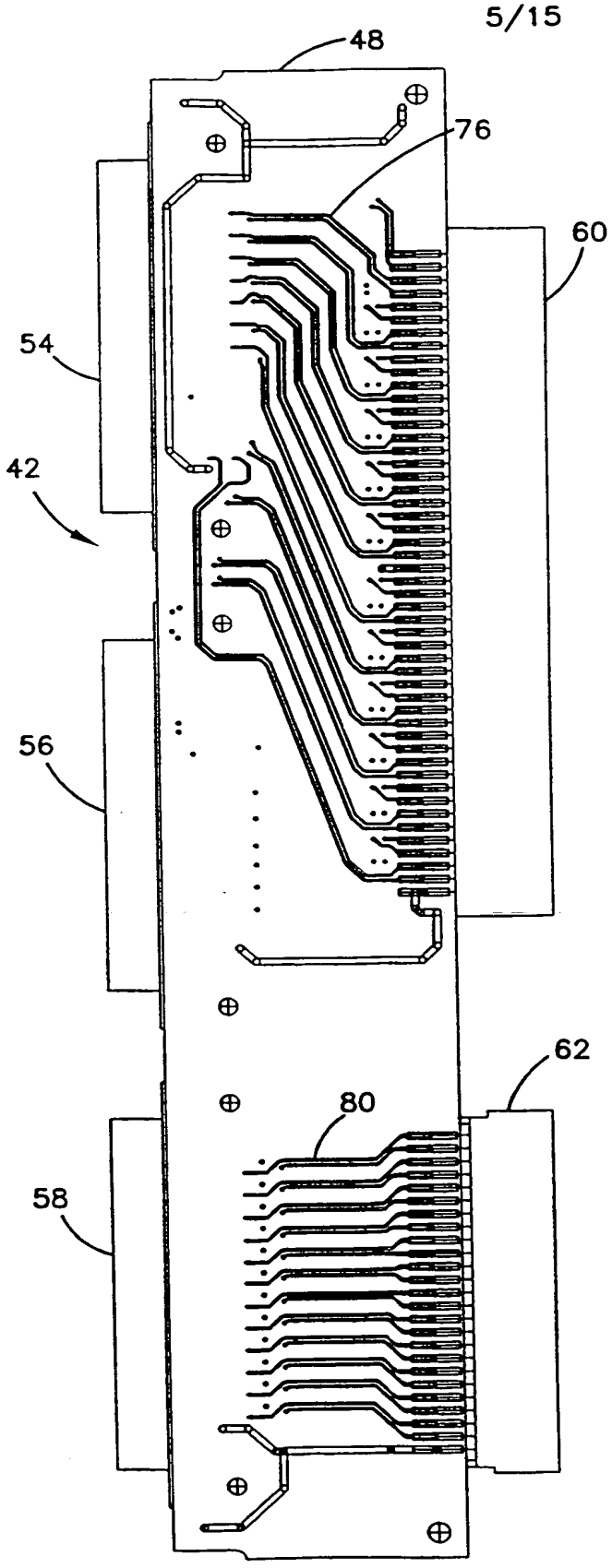


FIG. 5A

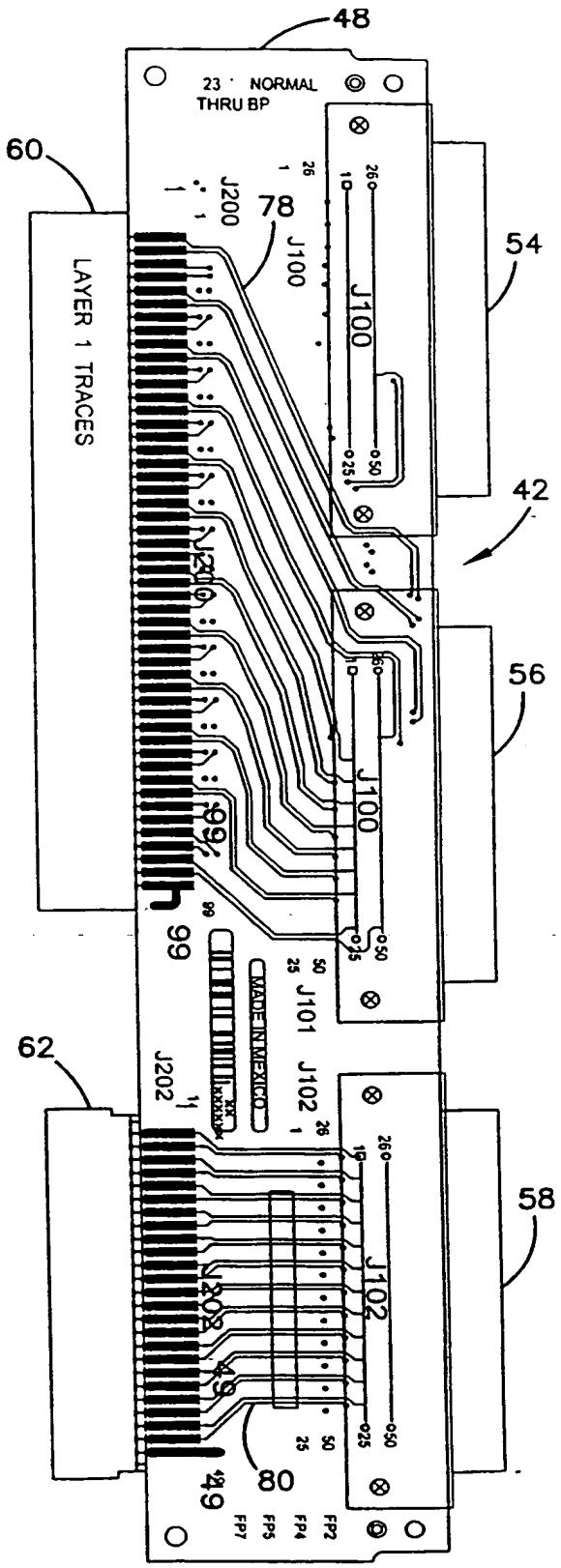


FIG. 5B

FIG. 5C

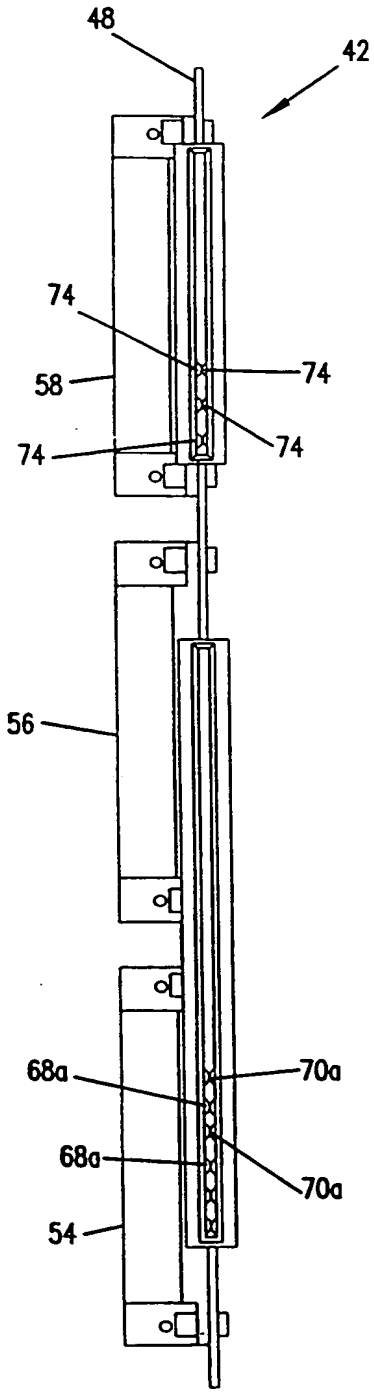
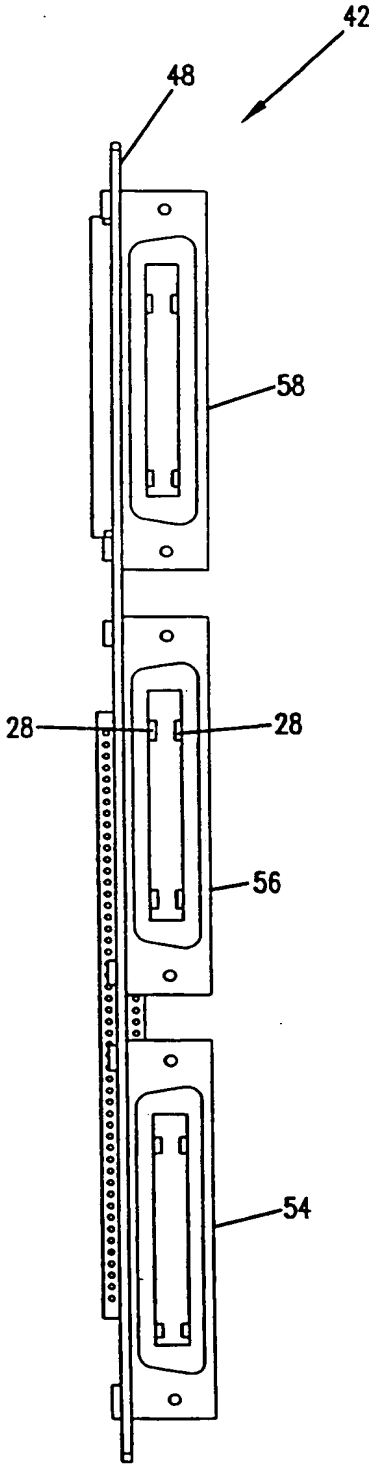


FIG. 5D



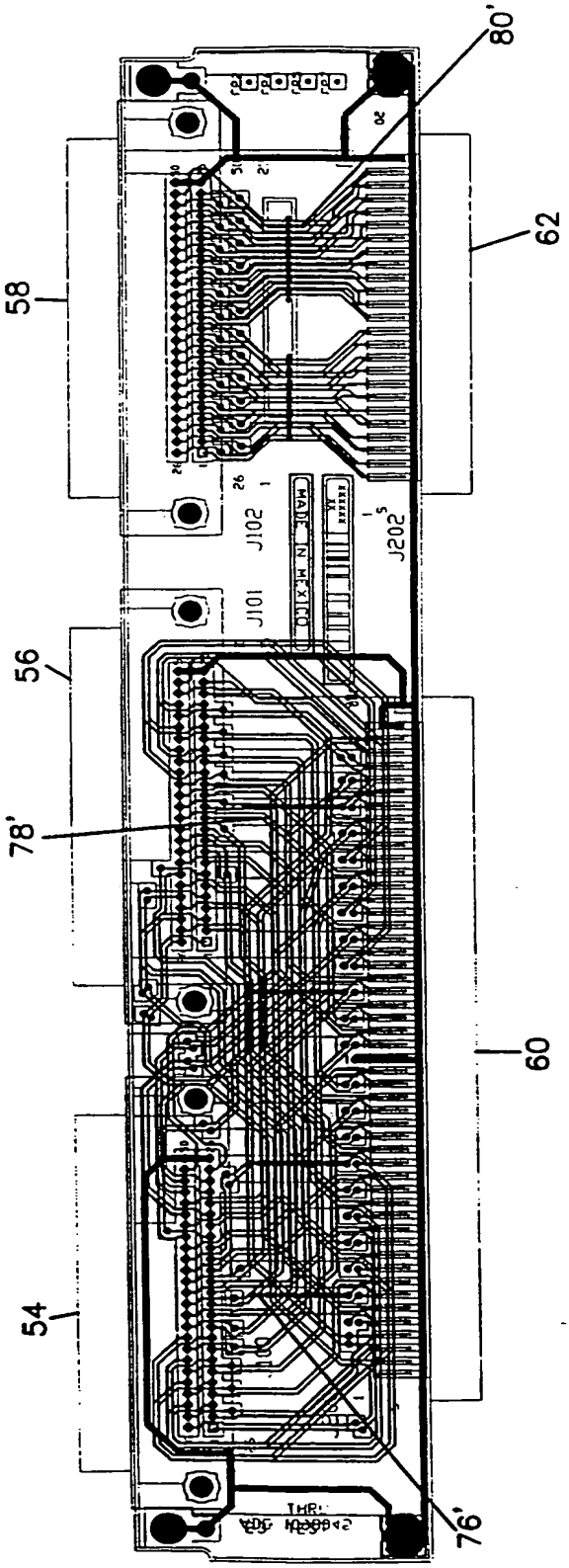
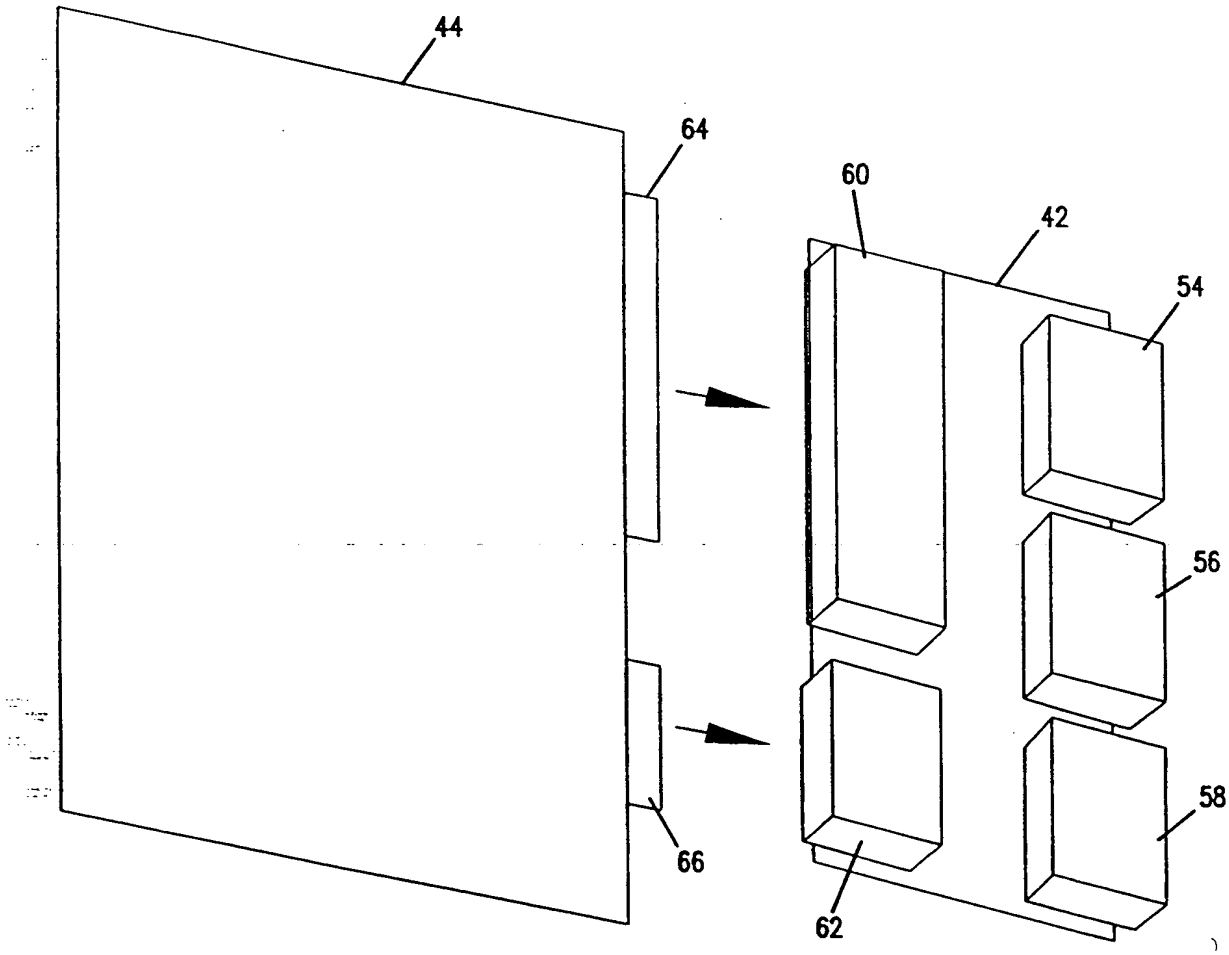


FIG. 5E

FIG. 6



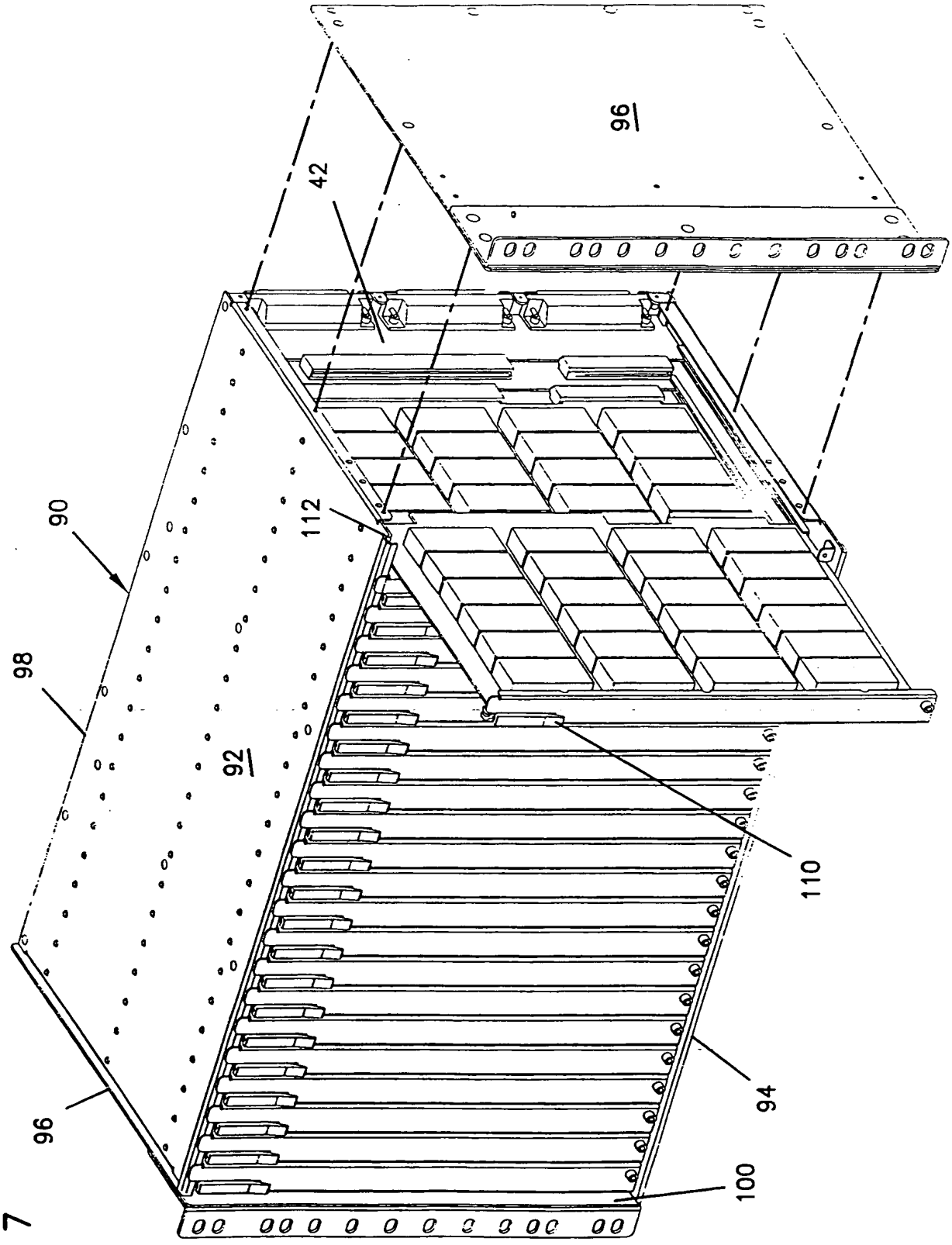


FIG. 7

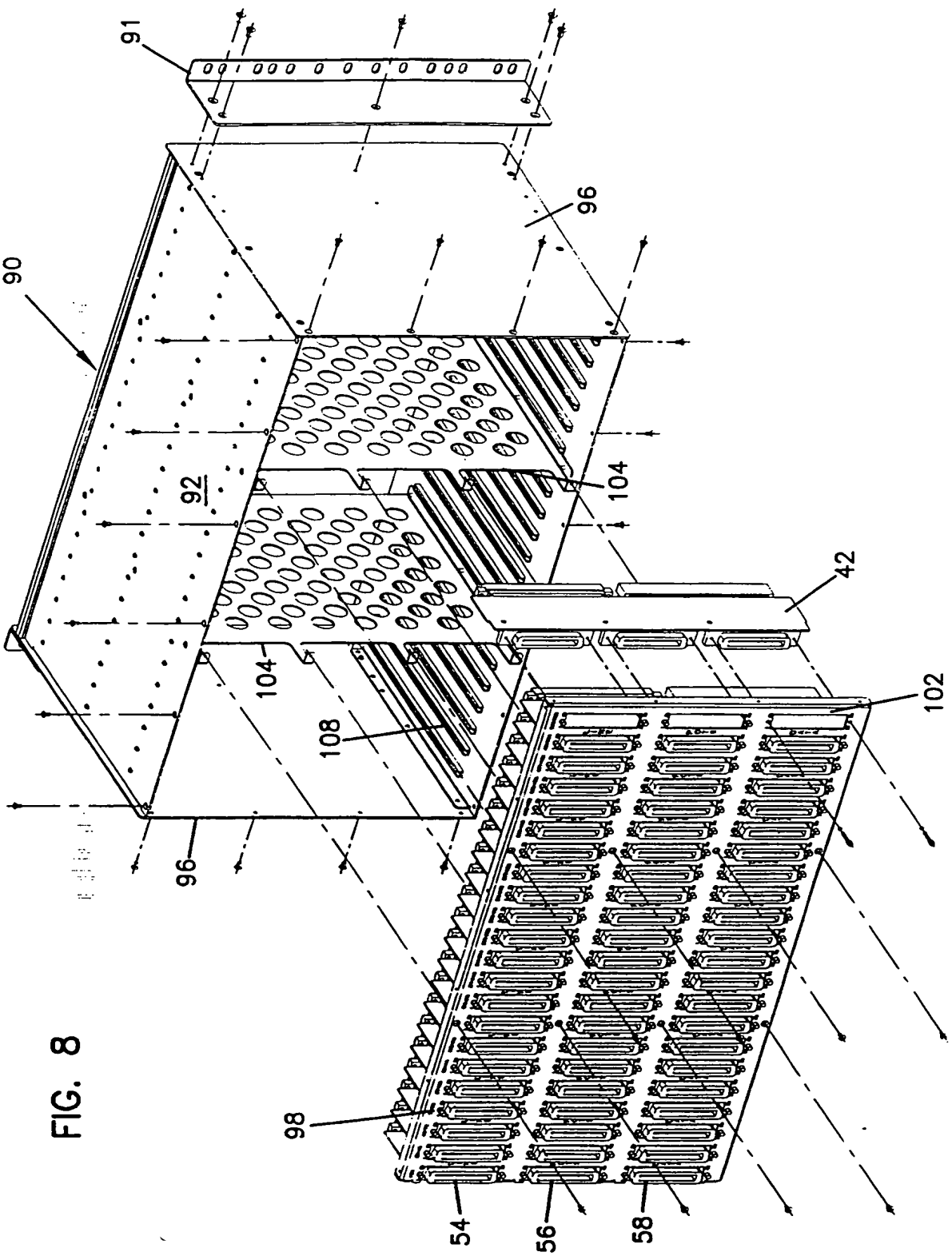


FIG. 8

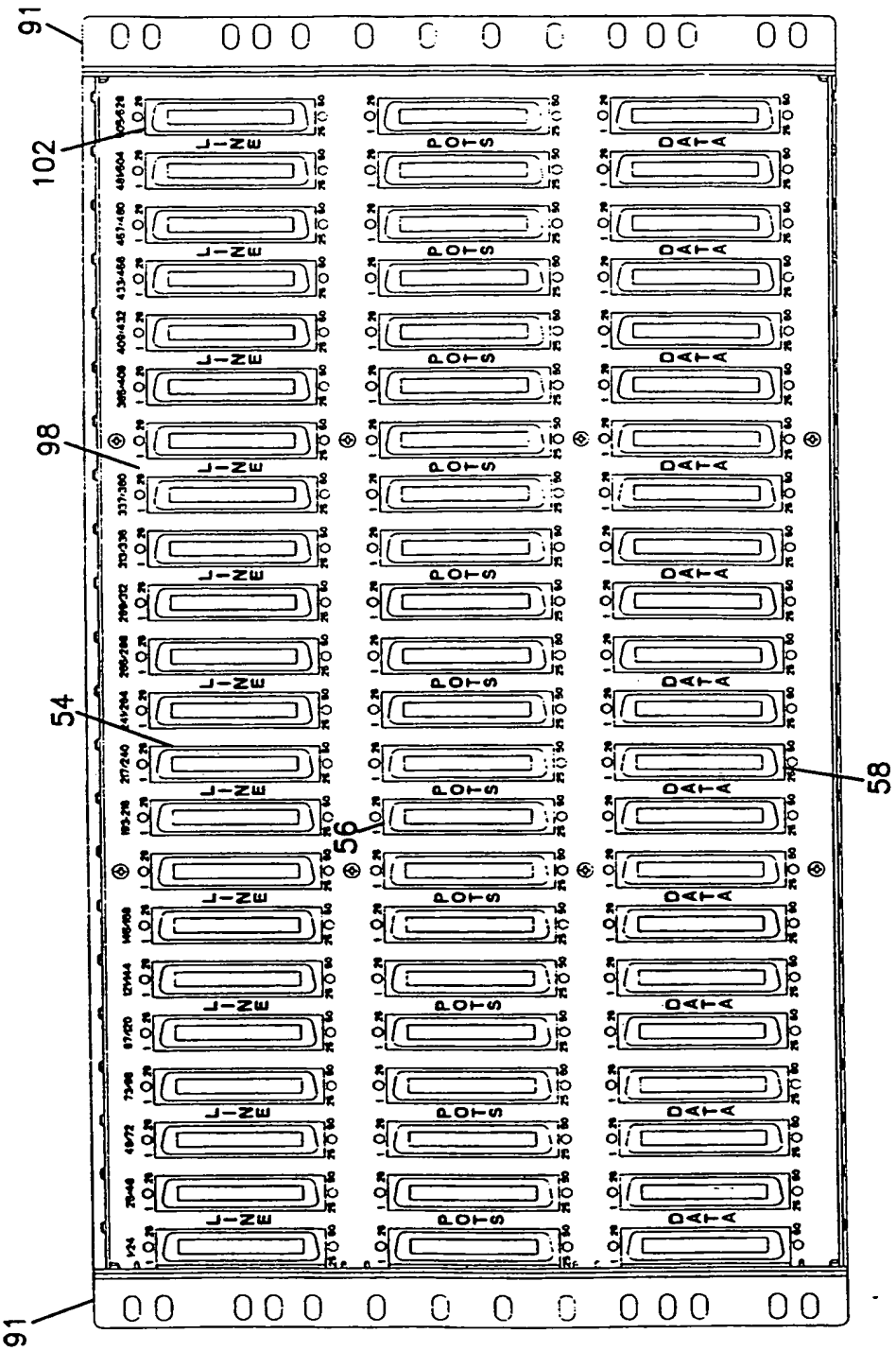


FIG.9

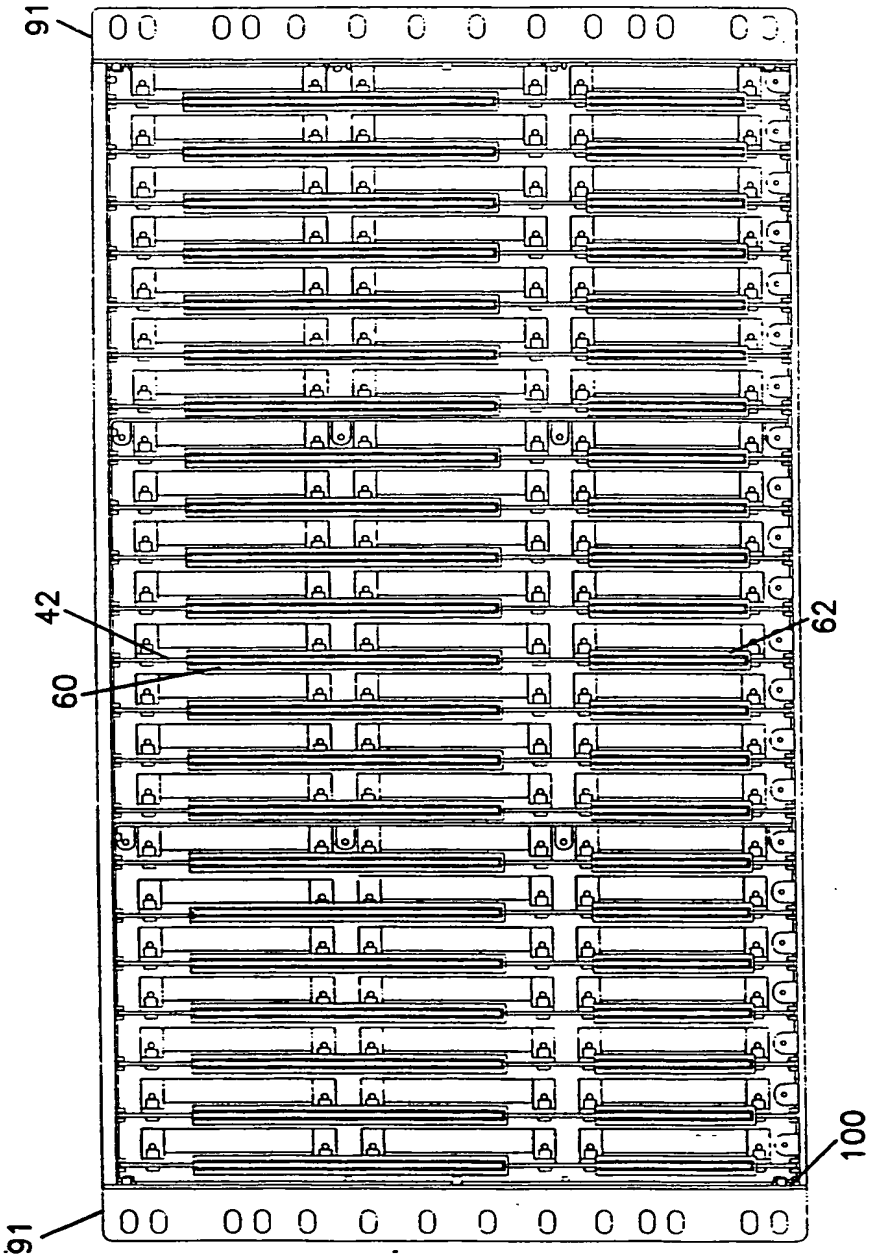


FIG.10

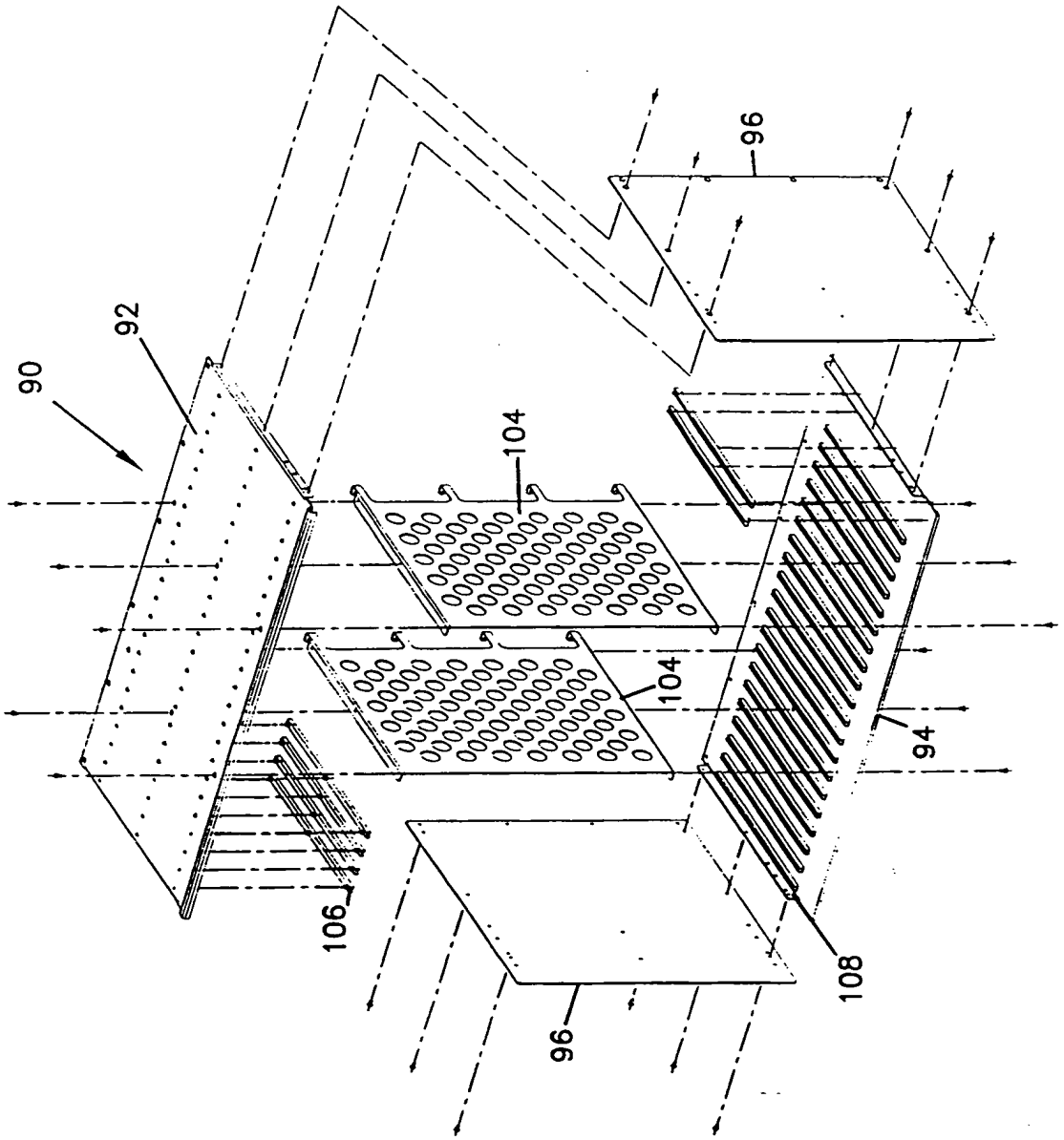


FIG. 11

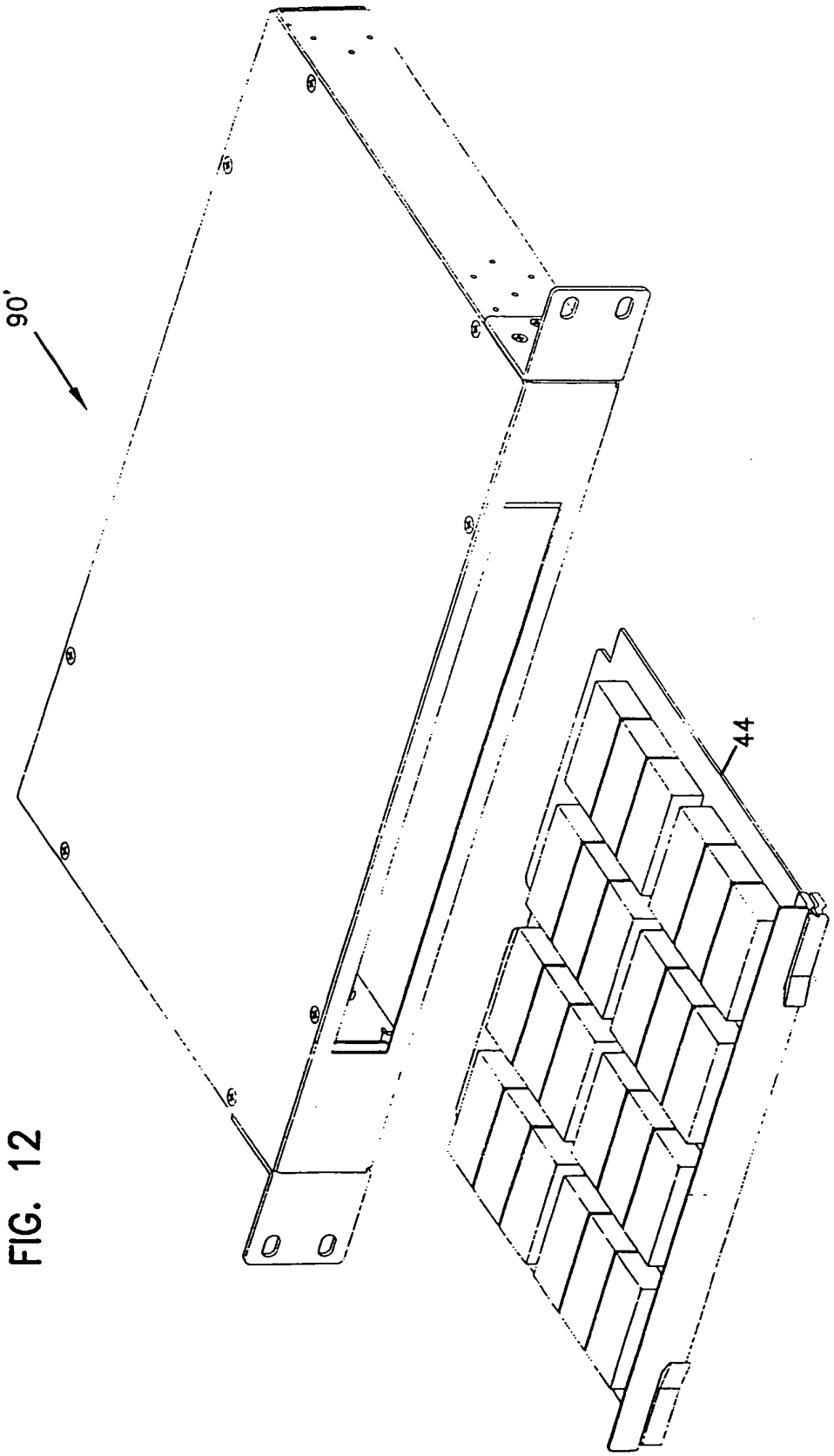


FIG. 12

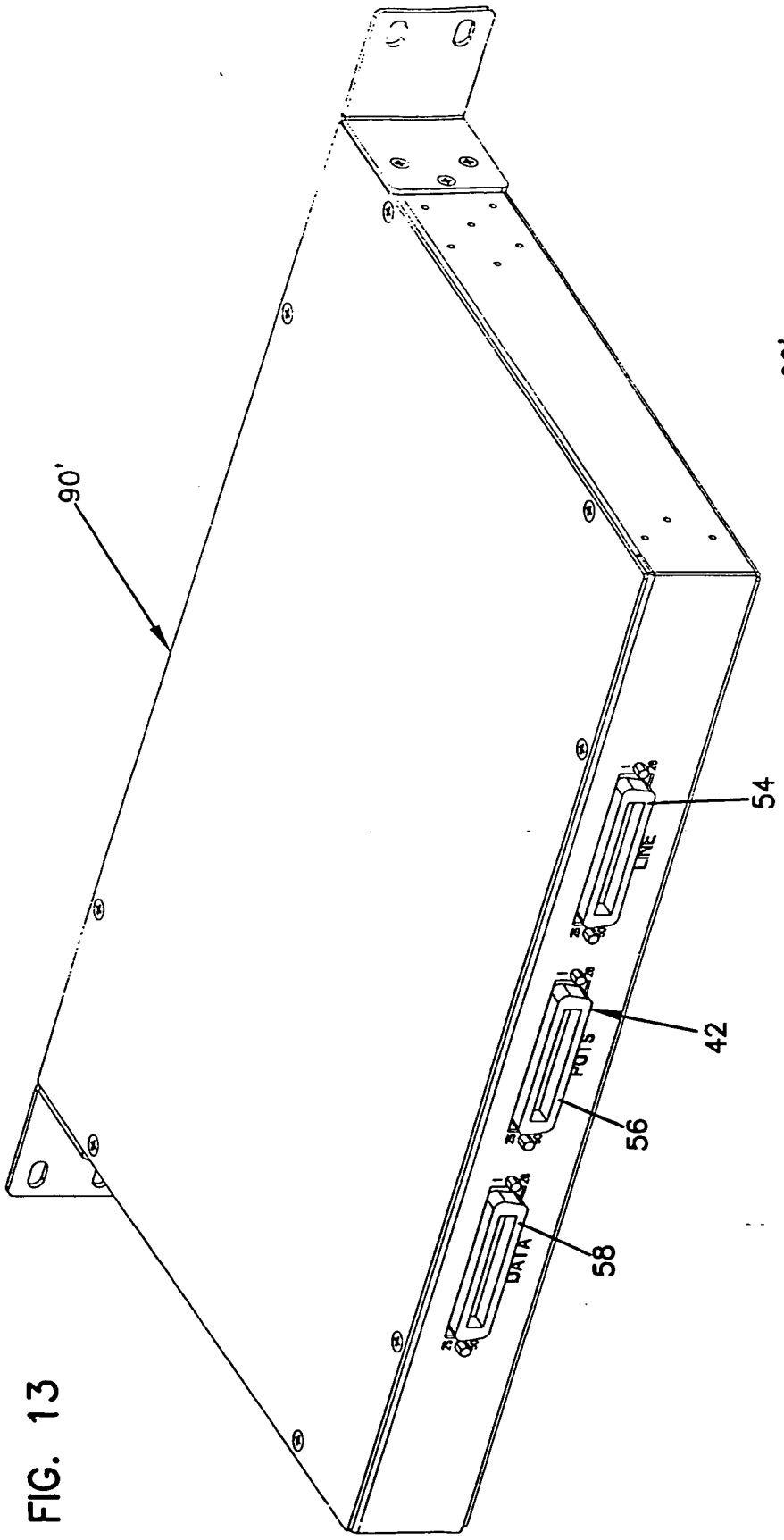


FIG. 13

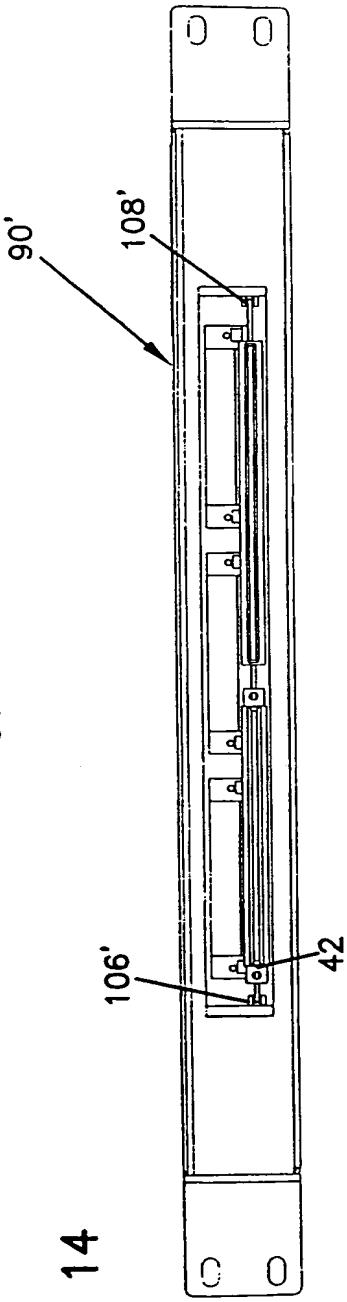


FIG. 14

INTERNATIONAL SEARCH REPORT

Intr tional Application No
PC1/US 01/11494

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04Q1/10 H05K7/14

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04Q H05K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
WPI Data, EPO-Internal, INSPEC, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
T	WO 01 45432 A (ADC TELECOMMUNICATIONS INC) 21 June 2001 (2001-06-21) the whole document ---	
A	EP 0 909 102 A (SIECOR CORP) 14 April 1999 (1999-04-14) the whole document -----	1-49

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
4 December 2001	11/12/2001

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Vandevenne, M

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

.nformation on patent family members

Intr tional Application No
PCI/US 01/11494

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 0145432 A	21-06-2001	AU 2260701 A	25-06-2001
		WO 0145432 A1	21-06-2001
EP 0909102 A	14-04-1999	BR 9804159 A	21-12-1999
		CA 2249085 A1	06-04-1999
		EP 0909102 A2	14-04-1999